JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOLUME 41 September 1951 No. 9

# MEDICINE.—*Disaster and disease.*[1]

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Accounts of epidemics associated with wars and disasters constitute a major part of recorded history. They form a somber and often mysterious background that frequently overshadows the intermittent brilliance of military and political glory.

In times past, these pestilences seemed pitiless and inescapable. Ignorant and often terrified, men did the very things that promoted the spread and severity of communicable diseases. Modern scientific knowledge has changed this situation: epidemics can be faced in an orderly manner; their dangers can be assessed from the sound basis of proved facts; specific measures to limit their threat can be taken with confidence.

Properly interpreted, the lessons of the past can give us confidence to meet the challenge of another world war capable of imposing catastrophe beyond anything heretofore known in history. So far as disease is concerned, we can expect to survive even the shambles of an atomic war if we use our knowledge and our resources properly. But we shall have to exert ourselves to do it; we cannot take it for granted.

## EPIDEMICS OF ANCIENT TIMES

Medical historians have long been fascinated and somewhat puzzled by a Biblical account of an epidemic following a military campaign. In I Samuel, it is told how the Philistines overcame the Jews and carried off their sacred Ark. This act so angered Jehovah that "He smote the men of the city, both small and great, and they had emerods in their secret parts . . . the hand of God was very heavy there. And the men that died not were smitten with the emerods."

The difficulty in understanding just what happened to the Philistines is that—as one historian puts it—"the Lord only knows what an emerod is" (*1*). Etymologically it is a hemorrhoid, but—as this same writer puts it—"it is hardly likely that even the Philistines could have had a fatal epidemic of hemorrhoids." Omitting the learned dissertations that have developed around this puzzling term, we may say that all medical historians come out with the conclusion that what Jehovah had dealt out to the Philistines was probably an epidemic of bubonic plague.

This uncertainty as to the exact identity of ancient pestilences is a prominent feature of medical history. The "plague of Athens" recorded by Thucydides is an example of this confusion. In 430 B.C. the Peloponnesians were attacking the cities of Attica, and the refugees from the hinterlands swarmed into Athens, which became greatly overcrowded. Suddenly a disease struck the city: "Athenian life was completely demoralized . . . there was no fear of the laws of God or man" (*1*). The Peloponnesians were so afraid of the disease that they withdrew from Attica. At the same time, Athenian naval action against the Peloponnesos was frustrated by the epidemic in the fleet. No one knows what this epidemic, which undoubtedly had an important role in Greek history, really was, or whether it represented one disease or several. In the second year of the epidemic more than 55,000 Athenians were said to have died of it, including Pericles himself.

[1] Address presented before the Washington Academy of Sciences, April 19, 1951.

In the time of Marcus Aurelius there was an epidemic that appears to have resembled in many respects the plague of Athens. This is known as the "plague of Antoninus"; it began in A.D. 165 in the Roman army of Verus, in the East. The army scattered the disease; it eventually spread over the entire Roman world, lasting 14 years. In Italy cities and villages were abandoned and fell into ruin; in A.D. 169, Roman armies campaigning against the Germanic tribes found many of the barbarians dead on the field from the epidemic. Marcus Aurelius died of it, too.

The great "plague of Cyprian" fell upon the whole known world in A.D. 250—Roman and barbarian alike. This epidemic (again its identity is uncertain) was spread by the active warfare of the time. According to one historian "men crowded into the larger cities; only the nearest fields were cultivated; the more distant ones became overgrown . . . farm land had no value" (*1*). A contemporary writer said the human race had been "all but destroyed" (*1*); the earth was returning to desert and forest. It is claimed that Christianity got a good start as a result of this pandemic, because of the great popularity of St. Cyprian as an exorciser of evil spirits.

Disaster and disease swept the Roman world for centuries: earthquakes, floods, wars, famine, and epidemics. The greatest of all pandemics of those times was the "plague of Justinian." It followed a succession of disasters, such as the earthquake that destroyed Antioch, killing more than 200,000 persons.

This "plague of Justinian" began in A.D. 540. According to a contemporary writer, "it spread over the entire earth and afflicted all without mercy . . . it spared no habitations of men, however remote" (*1*). The paramount historian of Rome, Gibbon, says that "no facts have been preserved to sustain an account or even a conjecture of the numbers that perished in this extraordinary mortality. I only find that, during three months, five and at length ten thousand persons died each day at Constantinople; and many cities of the East were left vacant, and that in several districts of Italy the harvest and the vintage withered on the ground. The triple scourges of war, pestilence, and famine afflicted the subjects of Justinian; and his reign is disgraced by a visible decrease of the human species which has never been regained in some of the fairest countries of the globe" (*1*).

The plague of Justinian lasted from 540 until 590. During this time, Italy was conquered by the Lombards; a contemporary writer said they "resemble in figure and in smell the mares of the Sarmatian plains" (*1*).

This pandemic is believed by many to have been bubonic plague, though some descriptions of the time are considered suggestive of smallpox.

## PLAGUE

The most devastating epidemic recorded in history was certainly one of bubonic plague: the "Black Death," which occurred exactly 600 years ago. This terrible affliction owed its inception to war. In 1346 the Tartars besieging the Don Cossacks in the Crimea were attacked by plague that is supposed to have been indigenous in the native rodents of the region. From them it spread to the besieged populations, and thence to China and India on one hand, and to Europe and Africa on the other. This was a true pandemic: an outbreak of disease that spread over most of the old world. It overran Europe from 1348 to 1352. It has been conjectured that 13,000,000 Chinese died of the Black Death. The population of England is estimated to have fallen from about 5 million to 2½ million. Somewhere from one-fourth to three-fourths of the population of Europe is said to have died in the three years beginning in 1348 (*2*).

For three centuries following the Black Death, plague smoldered in London, to break out into a furious epidemic in 1665. The population of London had suffered an unusually severe winter; plague began in the slums as winter ended. In this one year, it is believed to have killed nearly 110,000 out of London's 460,000 population. Defoe said, "London might well be said to be all in tears . . . The shrieks of women and children at the windows and doors of their houses, where their dearest relatives were perhaps dying, or just dead, were so frequent to be heard as we passed the streets, that it was

enough to pierce the stoutest heart in the world to hear them . . . Whole families, and indeed whole streets of families, were swept away together" (*2*).

Following this epidemic, plague disappeared from England and was not seen there again for nearly two and a half centuries. In Continental Europe, however, there were two major epidemics—one in 1770 and one in 1826. Both were generated by wars between Russia and Turkey. The first of these outbreaks is said to have caused 300,000 deaths in Hungary, the Ukraine, and Poland, and 50,000 deaths in Moscow—more than one-fourth of the population. The second epidemic killed 4,000 persons in three months in the city of Varna.

The last pandemic of plague began in southwest China about 1894. Reaching Bombay in 1896, it spread over India and by 1904 was responsible for 1,000,000 deaths annually in that country. Within six years every continent had become infected from this outbreak; in 1900 the disease was recognized in North America for the first time in history. Some writers refer to the situation now existing as the "present pandemic of plague," for the disease still lingers in many parts of the world to which it came with the great recrudescence around the beginning of the present century.

But there was only one Black Death.

## TYPHUS

The disease most frequently associated with war is typhus. Hirsch says, "The history of typhus is written in those dark pages of the world's story which tell of the grievous visitations of mankind by war, famine, and misery of every kind" (*3*).

The role of this specific disease in earlier times is obscure. It has been suggested that the epidemic that destroyed the army of Frederick Barbarossa in 1157 might have been typhus. Four days after the disease struck, the army, which had occupied Rome, abandoned the city and departed northward; the greater part of them died on the march.

Perhaps the first clear instance of a decisive role played by typhus in war occurred in 1566. An epidemic, quite evidently of this disease, broke out in the German army of Maximilian II, who was forced to abandon his entire campaign against the Turks in Hungary. This epidemic, called at the time "morbus hungaricus," spread over Austria, Germany, the Netherlands, and Italy, carried by returning troops.

The 30-years' war (1618–1648) was dominated by pestilence, of which typhus was a major cause. One historian says, "The sufferings of the German people during these thirty years are beyond telling" (*1*). When both plague and typhus struck, "in some villages the populations perished en masse . . . half the inhabitants of Munich died in 1634 . . . the population (of Germany) decreased by more than one-half" (*1*).

In 1632, at Nuremberg, typhus and scurvy together killed 18,000 soldiers, and the opposing armies of Gustavus Adolphus and Wallenstein left the field without battle.

Throughout the eighteenth century wars were followed by typhus. Hirsch says of this time, "As the oppression of war spared no country in Europe . . . so did the pestilence of war, particularly typhus, following at the heels of the conquerors and the conquered, spread all over Europe and rise to a terrible height in those places where the visitation of war had been most severe . . . in the universal distress caused by the war (it had) a very favorable soil in which to flourish" (*3*).

Of the many misfortunes that befell Napoleon's army in the Russian campaign, none had more effect than disease, particularly typhus. On the march to Moscow in 1812 the French were infected at Vilna; by the time the retreat had begun there was so much sickness in the Army that thousands had to be abandoned. "French soldiers . . . spread the contagion (typhus) over a large part of Central Europe. Almost naked . . . they marched through Poland and Germany. Typhus and other diseases associated with it marked their course. The inhabitants of the country were forced to house the sick; but teamsters also conveyed the infection to villages which the soldiers did not visit" (*1*).

"The number of persons who succumbed to typhus in Germany during the years 1813–1814 must be estimated at least as high as 200,000 or 300,000 . . . the number that contracted it would amount to 2,000,000," according to Prinzing (*1*). This would be

about 10 percent of the total German population.

Typhus was widespread among troops in the Crimean War (1854–1856), but there was no great amount of troop movement in this campaign, and civilian outbreaks did not develop. The troops in Crimea were severely stricken with an almost unprecedented variety of diseases, including—in addition to typhus—cholera and dysentery. In 1855, there were 48,000 casualties from sickness in 4 months. For the whole war—all armies—there were about 63,000 deaths from battle, compared with 104,000 from disease.

The greatest typhus epidemic of record accompanied World War I-on the southern and eastern fronts. In 1915, about 120,000 Serbs died between January and March, out of a population of 4,000,000. In 1920, there were more than 3 million cases of typhus reported in Russia, and as many cases of relapsing fever. Between 1917 and 1923, there are believed to have been 30,000,000 cases of typhus in Russia, and 3 million deaths.

All of this was brought about by war, revolution; famine, and the wanderings of homeless, unsupervised refugees, followed by movements of troops during the civil wars of 1919–1920.

### SMALLPOX

Another epidemic disease that has appeared in military history is smallpox. Some believe that it may have been responsible for the plagues of Athens and of Justinian. Many medical historians seem agreed that smallpox was absent from Greece and Rome during most of the classical period. It is supposed to have reached the middle east from Ethiopia in the fourth century A.D., during what was called the "Elephant War," and to have been carried into Spain by the Saracens, spreading thus over Europe. It had permeated Europe by A.D. 1000 and was repeatedly reintroduced by the Crusaders, and later by the Mongolians.

Smallpox is supposed to have facilitated conquest of the New World by the Spaniards: a Negro from a ship of Narváz carried it ashore and over 3,000,000 Indians eventually succumbed.

"The most furious epidemic of the 19th century" (*4*) was one of smallpox generated by the Franco-Prussian war of 1870–1871. At that time Germany was almost free from smallpox, but it was epidemic in Paris and elsewhere in France. Thousands of French prisoners, scattered throughout Germany, disseminated the disease which was then "conveyed from place to place . . . by the moving population itself, . . . by marching troops, and . . . by the removal of prisoners from one place of detention to another." From 1870–1874 there were 140,000 smallpox deaths in Prussia; in France 200,000 deaths in 2 years; in England 43,000 in the same period. In Austria 167,000 died in 6 years. The epidemic reached Scandinavia, Italy, and North America. "But the further the disease was removed from the seat of war the easier it was to control" (*4*).

### DYSENTERY AND TYPHOID

Dysentery and typhoid have been associated with wars of recent times. Napoleon's troops spread dysentery over Europe. In the American Civil War the diarrheal diseases—called "alvine fluxes" (*5*) by the medical writers of the time—accounted for 1,700,000 casualties and 45,000 deaths in the Union Armies, compared with 44,000 killed in battle and 49,000 dying of wounds. "No district in which troops were massed for war purposes was exempt from the scourge" (*5*).

In the Spanish-American war (1898) typhoid caused more casualties (20,904 cases, 2,188 deaths) than military action, and in the Boer War (1899–1902) it was a major problem. But though "troops in war time have suffered heavily from enteric fever (typhoid) the evidence of its introduction by them into civilian populations is small" (*4*).

### CHOLERA

Another of the great pandemic diseases, cholera, "is much more involved with pilgrimages than the movements of armies" (*4*). In India, which is the endemic home of cholera, it is spread by festivals and fairs; its importation to the West in times past has often been initiated by Muslim pilgrimages to Mecca. There are said to have been six pandemics of cholera in the past century or so. In four of these cholera reached the United States, the last time in 1911.

In 1833 it struck New York. A physician of the time said, "Our citizens had heard and read so much of this Asiatic scourge, and all we knew of it had impressed us with a sense of its mysterious character, its rapid and erratic course, its unmanageable and incurable nature, and its certain and dreadful fatality. Its fearful devastation in India and elsewhere had filled the mind with horror at the bare recital of its ravages, and the rumor of its appearance on the shores of the St. Lawrence threw our population into consternation . . . which, in some instances, became so intense as to dethrone reason itself and impel to suicide" (*2*). In 1849 cholera crossed the continent with the emigrant wagons, and in 1850 half the population of Sacramento fled from it; one-fourth of those who remained died.

### YELLOW FEVER

Yellow fever is not usually associated with war and disaster. It has tended to spread with peaceful commerce. But in one instance it played a critical part in military action. In 1801 Napoleon sent Leclerc with 25,000 French troops to Haiti to suppress the revolt. After defeating the Haitian Army, the French were struck by yellow fever. Of the Army of 25,000 Frenchmen, 22,000 died. In 1803 there were only 3,000 left to evacuate the Island.

### SYPHILIS

The spread of syphilis over Europe appears to have been the result of a specific military campaign. In 1494 Charles VIII of France invaded Italy and occupied Naples. The city was defended by Spanish soldiers, and it is believed that the latter had brought syphilis to the Neapolitan women. Charles's soldiery ran wild through the city, and contracted the disease. Then the invaders withdrew and scattered over Europe. Wherever they went, syphilis appeared: France, Germany, England, Scotland, Russia—even to far-off China, and Africa. Why did it spread in such sudden and dramatic fashion? Perhaps we shall never know entirely, but two important factors were:

1. It was a time of great floods, drouth, and excessive heat. Plague, ergot poisoning, and other illnesses had decimated the population and weakened resistance.

2. It was a period of unprecedented licentiousness. Says Hirsch: "The corruption of morals had at the time reached a height which even contemporary writers tell us was without parallel in ancient times" (*3*).

### INFLUENZA

The greatest pandemic of modern times was that of influenza in 1918–19. "While all Christendom bent its energies to the killing of young men, nature outstripped the statesmen: influenza killed more victims in a few months than all the armies in 4 years" (*2*). In the United States there were 20 million cases and around a quarter of a million deaths. "In India 6 months of influenza accounted for nearly as many deaths as 20 years of cholera" (*2*). It is estimated that there were 200 million cases in the world, and more than 10 million deaths. "The pandemic of 1918 and 1919 ranks with the plague of Justinian and the Black Death as one of the 3 most destructive outbreaks of disease that the human race has known" (*2*).

"Yet we are struck by the absence, in 1918, of the degree of panic and desolation which is reported for comparable waves of death in earlier years . . . it seems that human composure was not so shaken by this disaster as it had often been before by those of smaller compass . . . disease was no longer so mysterious, so portentous an experience as it had once been. After a generation of research, infection was comprehensible, even though this particular infection still proved baffling" (*2*).

In the United States "one person in every 4 fell sick. . . . The Black Death killed 9 out of 10 whom it attacked, cholera sometimes 4 out of 5; influenza in 1918, only *2 or 3* out of a hundred" (*2*).

### WORLD WAR II

These brief glimpses of medical history illustrate the importance of disease—particularly communicable disease—in the development of civilization. They show how epidemics are generated by wars and by the disastrous conditions which accompany and follow wars.

The greatest war of all time is still fresh in our memory. And one of the most amazing features of this war is the fact that, catastrophic as it was, beyond anything known to history, it produced no major epidemics.

World War II was distinguished by all the conditions which appear to have facilitated the dissemination of epidemics in all previous major wars, such as:

1. Movements of great bodies of troops over long distances. In World War II there was constant interchange of troops among all the major regions of the earth. They passed through or sojourned in areas where such diseases as plague, cholera, yellow fever, and smallpox were prevalent.

2. Displacement of civil populations, with great masses of wandering, homeless refugees. This occurred in the Orient and in Eastern Europe—both regions where epidemic diseases are indigenous—as well as in the relatively healthier countries of the West.

3. Breakdown of civil authority, with consequent failure to maintain the sanitary practices of normal times.

4. Tremendous destruction of cities, with disruption of water supplies, sewage systems, food sanitation, and the like—all because of irreplaceable losses in plant and equipment.

The "epidemic potential" must have been high. There were indeed numerous epidemics of circumscribed extent. Plague broke out several times in North Africa; there was a serious epidemic of typhus in Italy, centering around Naples; cholera caused our military authorities some concern in the Orient. Smallpox repeatedly presented a challenge: it got out of hand for a time in Japan, and spread to the United States and to England among returning troops. Hundreds of thousands of soldiers acquired malaria, bacillary dysentery, and amebiasis. There were a number of outbreaks of infectious jaundice. Diseases like "mite typhus" and filariasis were important military medical problems.

But there were no pandemics, nor threats of any.

The explanation for this failure of epidemics to get out of control in World War II relates to our modern knowledge of the factors which favor the dissemination of specific communicable diseases, and our ability—because of such knowledge—to alter these factors to our advantage.

At the time of World War I we understood a great deal about the method of spread of epidemics, and could control most of them, but our methods were either cumbersome or not efficient. Between World Wars I and II, and during World War II, there were many improvements in knowledge and resources:

1. The sulfonamide drugs and the antibiotics for treatment of many communicable diseases (e.g., plague, dysentery).

2. D.D.T. for the control of vermin (e.g., lice, fleas).

3. Better and more accurate methods of diagnosis (e.g., extension of the complement fixation test, advances in virology).

4. Better vaccines, to provide more reliable immunity (e.g., yellow fever, typhus).

## PRESENT PROSPECTS FOR EPIDEMIC CONTROL

Since World War II, even more advances have been made. There are several new antibiotics (such as chloramphenicol and aureomycin) that give us the upper hand over many more diseases than we ever had before. There are new rat poisons, important in reducing the hazard of plague. The virus that causes influenza, unknown during the pandemic in 1918, has been studied with increasing thoroughness, and better vaccines are being developed. Better methods of water purification appear possible, not that we need any safer water than we have now in our cities; but these methods might be more adaptable to emergencies.

If there should be a World War III, we all know that it would be terrible. We expect that our cities would suffer enormous destruction. Water supplies, sewage systems, and other sanitary mechanisms would be destroyed or disrupted for long periods. Hospitals would be jammed with casualties, as indeed would many other buildings which would have to be converted to shelter the injured. Medical and allied professional people would be tremendously burdened. Civil authority would have to exert its utmost effort to meet such catastrophes. Un-

der such conditions, what must we expect in regard to epidemics?

My answer is that we would have epidemics. We always have them. They are going on right now. There was an epidemic of influenza last winter—several of them if you care to look at it with great exactitude. There will be epidemics of poliomyelitis this summer. In India there will probably be epidemics of cholera in a month or so—there always are. There will be outbreaks of yellow fever in South America this year, as there have been at intervals for generations. There was a case of bubonic plague in New Mexico in January; last year there were five cases in the United States as a whole. (In 1925 there was an epidemic of pneumonic form of plague in Los Angeles, and 33 people died of it.)

During the past four years there have been apprehended at various quarantine stations 8 ships infected with cholera, 88 with smallpox, and 1 with plague.

Epidemics of such diseases as influenza, cholera, plague, and typhus and outbreaks of yellow fever and smallpox scarcely come to the notice of the general population nowadays, although there is no attempt to conceal them. Indeed, there is rapid exchange of such information all over the world (*6*, *7*). But since the outbreaks either do not get out of hand or, if they do, are brought under control with confidence and dispatch, the general public is not too concerned about them.

If war should come, outbreaks of this sort would have to be regarded with more concern than they merit in times of peace. We should have to take them quite seriously and apply our knowledge and our resources as quickly and thoroughly as possible to bring them under control or to keep them from getting out of hand.

The important point is that we do have the knowledge to make it possible to do this. To the extent that our physical plant is damaged, and our supplies of medicines, vaccines, insecticides, and the like may be destroyed, it will be more difficult to apply that knowledge. But no matter how many difficulties of this sort may develop, we still have the knowledge—which is where we differ basically and completely from our predecessors of earlier times, who had recourse only to guesswork, superstition, and flight.

We do not expect to escape any war without suffering and death. That is the price of war. Part of that price will be paid in increased communicable diseases, in epidemics, and in deaths from epidemics. We must face this, just as we must face the appalling destruction that would come from atom bombs.

Why not hedge against this danger of disease by immunizing everyone in advance? We can vaccinate against influenza, cholera, plague, typhus, and so on. The Armed Forces are immunized against quite a variety of diseases, as everyone remembers who has stood in line for "shots."

But what we need to meet the threat of atomic war is careful judgment, based on assessment of all the factors—not rule-of-thumb, or an "easy way out."

To immunize 150,000,000 people against all the diseases for which we have vaccines would consume tremendous resources in terms of manufacturing capacity, trained personnel to administer the injections, maintenance of records, and general administrative arrangements. Even were we willing to make such a commitment, many of our immunizations could not be relied upon to protect every person inoculated. And since nearly all give only temporary protection, they would have to be repeated—for who knows how many times?

This does not mean that all immunizations are impractical—far from it. Speaking only for myself, I believe that we should immunize as many people as possible against smallpox and try to keep them immunized. I also feel that we should immunize all children against diphtheria, whooping cough, and tetanus. But this is nothing new at all; it is part of our regular peacetime public-health program. In addition, I think that if war is anticipated we ought to immunize everyone who is likely to be in a target area against tetanus.

That is as far as I should go in immunizing the population generally. Beyond that, I should rely on our scientific knowledge, our medicines and chemicals, and our judgment, to pull us through. We can boil

our water if we have to, or put tablets of disinfectant in it. We can bury our excreta and food wastes. We can treat patients with drugs and antibiotics to reduce reservoirs of infection. We can attack insects and rodents with established methods.

Above all, I believe we should diligently encourage research. We must base our plans for defense upon the most thorough consideration of the knowledge we have; meanwhile we must continue with utmost vigor to increase and improve our knowledge and understanding.

## BIOLOGICAL WARFARE

We have been told that another war might bring into use a new weapon—one never before tried—biological warfare. This means the intentional use of disease-producing microorganisms or their products to cause casualties in a target population. We must consider this possibility in our plans for defense. Biological warfare may never be used, but if it is we want to be ready to defend ourselves.

The same principles that apply to control or prevention of diseases of natural origin apply to defense against biological warfare. Our knowledge of the biology of disease, our medicines and techniques, and our experience in public-health operations will be brought to bear on any problem that might arise in this manner, and we can expect them to be effective.

If biological warfare is used against us, it may be anticipated that the agents employed will be those we meet in regular public-health practice. It is not expected that strange new organisms would be employed, or that mysterious or unpredictable outbreaks of disease would be produced. In fact, most of the organisms that would appear to possess the qualifications that one would regard as essential for use in biological warfare would not spread from person to person. Self-perpetuating epidemics would be most unlikely. It is well to remember that it has never been shown that an epidemic could be started intentionally. In fact, it is not known just how or why an epidemic starts or fails to start in nature. Greenwood says, "In plague, as in other sicknesses, something more is needed to generate an epidemic than even widespread and quite uncontrolled means of infection" (4).

What has been said about disease arising from atomic disaster applies to the possibility of biological warfare. We would expect casualties—and deaths—but we would also expect to be able to bring the situation under control. In regard to immunization, the same principles would apply as for atomic warfare and general disaster. For biological warfare, we might consider broadening a bit the scope of immunization, but only on the basis of careful assessment of all the factors—not an over-all procedure to provide what might superficially appear to be an easy answer.

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ETHNOLOGY.—*Medicinal plants used by Choctaw, Chickasaw, and Creek Indians in the early nineteenth century.* T. N. CAMPBELL, University of Texas. (Communicated by Frank H. H. Roberts, Jr.)

What is known today about medicinal plants used by the Indians of the Southeastern United States is based largely on information accumulated by ethnologists within the present century. Most of this has been summarized by Taylor (1940), who has compiled data on 185 plants used by eight Southeastern groups—Cherokee, Catawba, Creek, Alabama, Koasati, Chickasaw, Choctaw, and Natchez. The literature on these Indians prior to the period of enforced removal (circa 1830–1850) contains very little specific information on medical ethnobotany. For this reason the material presented below is of special interest. It was obtained by Gideon Lincecum, a self-taught physician and naturalist, from Choctaw, Chickasaw, and Creek Indians in the States of Mississippi and Georgia during the years 1800–1835. It is a partial but acceptable record of medicinal plants used by these three Indian groups in the early nineteenth century. The comparatively early date of this record makes it possible to note changes that have taken place in the herbal medicine of these Indian groups over a period of approximately one hundred years.

The names and medicinal uses of the plants presented on the following pages have been taken from Lincecum's medical herbarium of plants native to the Southeastern United States. This herbarium, which consists of 305 pressed plants, is now in the possession of the University of Texas Library in Austin. The plants were collected by Lincecum in eastern Mississippi and southeastern Texas over a long period of time, but principally between the years 1830 and 1868. On the outside of each folder, in Lincecum's handwriting, is the scientific name of the plant, the English name or names, occasionally an Indian name, along with data on the part or parts of the plant used for medicinal purposes, the method of preparation, the medicinal properties (based on Lincecum's own clinical observations), and the disease for which the prepared drug was used in Lincecum's practice. Twenty-two of the folders include miscellaneous remarks on the medical use of the enclosed plants by Choctaw, Chickasaw, and Creek Indians. The plants from these 22 folders have been examined and identified by Dr. Benjamin C. Tharp, Department of Botany, University of Texas, whose assistance is gratefully acknowledged.

Published biographic materials afford some basis for evaluating the reliability of Lincecum's ethnobotanical notes. (Geiser, 1948, pp. 199–214; Lincecum, 1904a) Lincecum was not medically trained in the orthodox manner of his day, i.e., by study at a medical college or with a licensed practitioner. He learned medicine by reading medical literature. He learned systematic botany in the same way, and it is of interest to note that the specimens in his herbarium are, with few exceptions, accurately classified for his time. This lack of formal training probably explains some of Lincecum's readiness to adopt Indian herbalism.

Of more importance is the biographic evidence of close association with the three Indian peoples in question. The first 25 years of Lincecum's life (1793–1818) were spent on the outer fringe of the Georgia frontier, where he had ample opportunity to observe the Creek Indians. For a period of 30 years (1818–1848) he lived in eastern Mississippi near the present town of Columbus. Until the period of removal, this was near the boundary that separated the Choctaw and the Chickasaw. For several years Lincecum operated two trading posts, one patronized principally by the Choctaw, the other by the Chickasaw. He spoke the languages of both groups. During the early 1820's he recorded—in the Choctaw language, using the Roman alphabet and various diacritical marks—a long traditional history of the Choctaw as related by an old and learned Choctaw man. A translation of this survives and a portion of it has been published (Lincecum, 1904b).

It is very clear from his autobiography that Gideon Lincecum had a detailed knowledge of Choctaw medicinal plants. In the early 1830's, having lost a number of pa-

tients, he became dissatisfied with the medicines he was using and decided to investigate Choctaw herbal medicine. He got in touch with the leading doctor (*alikchi chito*, "big doctor") of the Southern or Sixtowns group of Choctaw. This Indian doctor was evidently much disturbed by the advanced stage of Choctaw acculturation at that time, for he sent word to Lincecum that he would be "willing to teach what he knew about medicine before he died to somebody, and to a white man in preference to his own people, because the white man would place it on paper and preserve it" (ibid., 1904a, p. 494). The pay for his services as an informant was to be 50 cents a day and his food.

The Choctaw doctor met Lincecum at a certain bluff on the Noxubee River, and the two men lived in the woods for six weeks. The Choctaw collected plants alone during the day, and in the evening before a fire "he unrolled his specimens of medicinal plants and laid them in order on his right hand where he was sitting. He then took them up, one by one, described the kind of soil they were found in, their use, the season to collect them and what other plants they were sometimes combined with" (ibid., pp. 495–496). Using his system for recording Choctaw, Lincecum wrote down everything that the doctor told him, and he also preserved small specimens of each plant. At the close of the 6-week period the doctor had Lincecum read back to him everything that he had dictated. At this time errors were corrected and additions made.

Unfortunately this remarkable record of Choctaw medicinal plants does not seem to have survived. It is not among the Lincecum manuscripts in the University of Texas Library, and the living descendants of Lincecum do not know of it. Nothing remains but the scattered remarks in Lincecum's medical herbarium. Undoubtedly many other plants in the herbarium were used by the Choctaw, but the present record does not permit them to be specified.

In the sections that follow only such passages have been taken from Lincecum's herbarial notes as seem to be pertinent to Indian medicinal usage. Lincecum's statements are enclosed in quotation marks. When Lincecum gives Chickasaw or Choctaw names, the nearest equivalents in Byington's Choctaw dictionary (Byington, 1915) have been inserted in brackets. Aside from simplifying the spelling of a few words, such as "Chocktaw" and "Chickesaw," no further editorial changes have been made.

## CHOCTAW

Cushman (1899, pp. 228–229) has given the English names of seven medicinal plants used by the Mississippi Choctaw, presumably in the middle of the nineteenth century. Fifty-three medicinal plants have been reported in the literature of the current century. From the Choctaw of Bayou Lacomb in southeastern Louisiana Bushnell (1909, pp. 23–24) collected 25 plants in 1909. All these are identified by scientific name as well as by Choctaw name, and only one appears on Cushman's earlier list (its use is not given by Cushman). About 1918 Swanton (1931, pp. 237–238) obtained a list of 12 medicinal plants from a Choctaw informant in eastern Mississippi. These plants are identified only by Choctaw and English names, but they do not appear to duplicate any plants on the Cushman and Bushnell lists. Taylor (1940, *passim*) does not make use of the Cushman and Swanton lists, but she incorporates the Bushnell list of 25, to which are added plants collected in her own field work among the Choctaw in the 1930's. She does not state whether her field work was done among the Mississippi or the Louisiana Choctaw. Her contribution to Choctaw medical ethnobotany consists of new uses for six plants on the Bushnell list and 16 plants previously unreported from any Choctaw group. To this may be added the Lincecum record, which provides data on 16 plants used by the Choctaw early in the nineteenth century:

*Polygonum aviculare* L., deerweed, knotgrass, pinkweed. "Whole plant. A strong tea of this plant drunk freely, is the Choctaw remedy to prevent abortion. They have the utmost confidence in its powers; they all know it, and consequently abortion is a circumstance of very uncommon occurrence."

*Heuchera americana* L., alum root, rock geraneum. "The root. Astringent, tonic. This is a

valuable remedial agent, useful in all cases requiring powerful astringents; it has been noticed and used by all the different aboriginal tribes with whom I have become acquainted in the South [Choctaw, Chickasaw, and Creek]."

*Tephrosia elegans* Nutt. Lincecum does not link this plant with any specific Indian group, but in view of certain remarks in his autobiography it is most likely of Choctaw origin. "The root of this plant is an excellent article in bad coughs. The method of using it, is, to carry it about you, and chew it frequently through the day, swallowing juice. If the bowels become loose, you have swallowed a little too much; diminish the quantity so as to properly regulate the bowels, and continue its use for a long time. This is an Indian remedy. . . "

*Geraneum maculatum* L., spotted crane's-bill. "Root. Powerful astringent. The Choctaws consider it as the most effectual of their remedies for the cure of the venereal."

*Vitis aestivalis* Michx., summer grape. "Refrigerant, tonic, acid. I was witness to a case while I resided with the Choctaw Indians, which to me was very singular. There was a woman between 14 and 15 years of age, who died in childbed, leaving her infant child to the care of its grandmother. This old woman was 55 years of age when she took the child, and had not nursed a child since the mother of the infant in question was weaned. She took the infant and as is the custom with Indian women, she cried and grieved over it, sympathizing with and strongly desiring that she might give nourishment to it, and be able to raise up the infant to fill the place of its deceased mother; and all the time, as often as five or six times a day she washed her breast with and drank freely of the water of the grape vine. The result was that in the course of a week she began to secrete milk, and very soon her breasts were full and plump, and she nourished the child sufficiently to keep it healthy and fat. She told me that it was the custom of her country women."

*Sida hederacea* Torr., round-leaved sida. "Choctaw name: *Shaka oakheesh* [probably *sheki*, buzzard; *okhi"sh*, medicine]. The root. Mucilaginous. It is used by the Choctaws in dysentery, diarrhea, inflammation of the bowels, burns, etc. The root when dried is easily pulverized. . . " The Choctaw, like the Creek and Chickasaw, believed that many diseases were caused by animals. (Sawnton, 1931, pp. 235, 237). *Sheki okhi"sh*, "buzzard medicine", may indicate that certain intestinal disorders were ascribed to this bird. For reference to another animal, the fox, see *Eryngium aquaticum* below.

*Aralia racemosa* L., American spikenard, Indianroot. "Choctaw name: *tally thla,po,la* [possibly *tala*, name of a certain root; *lopoli* to pass through slowly]. The berries, the root. Stimulant, expectorant. The Choctaws use it for many complaints among their children. In all cases where we use paregoric, Bateman's drops, Godfrey's cordial, etc., they use the spikenard. . . For this purpose they boil a little of the root in clear water, sweeten the decoction, and give it pretty freely to children of any age, who are troubled with gripes, colic, etc. . . In bad cases of putrid sore eyes, the Choctaws boil up a quantity of the root, and while it is boiling, hotsteam their eyes over it. Two or three applications generally cure them."

*Eryngium aquaticum* L., bitter snakeroot, rattlesnake master. "Choctaw name: *Pis, hok, chu, la* [*pishuk*, name of a weed used in dying red; *chula*, fox]. The root. Powerful diuretic, expectorant, stimulant, and anti-poison—good for snakebite. The Choctaw cure gonorrhea with this plant."

*Asclepias verticillata* L., milkweed. "The root. Sudorific, stimulating. The Choctaws esteemed it among their most valuable remedies for snakebite. They administered it in strong decoction, and chewed the root, swallowing the saliva while chewing."

*Cephalanthus occidentalis* L., buttonbush. "Bark of the root and of the tree. Tonic, febrifuge. A strong decoction of the bark of the tree is a favorite medicine with the Choctaw Indians for dysentery."

*Galium asprellum* Michx., bedstraw. "Whole plant. Diaphoretic, diuretic. The Choctaw cure measles with it—and go in the rain, water, and cold all the time."

*Galium boreale* L., bedstraw. "Choctaw name: *Ahoyo oakheesh* [*ohoyo*, woman; *okhi"sh*, medicine]. The whole plant. Diuretic, diaphoretic, and deobstruant. This is the article [decoction made from the whole plant] used by the Choctaw women for the purpose of preventing impregnation. They told me that it proved uniformly successful, without injuring the health! I have abundant testimony of this statement."

*Galium uniflorum*, Michx., bedstraw. "Whole plant. Astringent, good dye weed. The Choctaws made frequent use of this family of plants, in all cases requiring diuretic, and diaphoretic action."

*Nabalus asper* (Michx.) T & G, rough white lettuce. "Secernant, stimulant, anodyne. Electchee Chitto [Alikchi Chito], the Six Town doctor, used a decoction of the roots and tops of this plant as a stimulating diuretic and anodyne, taken occasionally, according to its effects on the patient." Reference is made here to the Choctaw doctor who met Lincecum in the woods and taught him Choctaw herbal medicine.

*Eupatorium ageratoides* L. f., white snakeroot. "Choctaw name: *noota ikheesh* [*noti*, tooth; *ikhe*$^{n}$*sh*, medicine]. Warming stimulant and tonic. The Choctaw and Chickasaw Indians use it, by chewing and holding the roots in the mouth, for toothache."

*Echinacea purpurea* (L.) Moench, purple coneflower. "The tincture of the roots of this plant has been used with success in bad cough, and dyspepsia attended with a bad cough. . . The Choctaws use it for the above purposes, by chewing and swallowing the saliva. They keep a small piece of the root in the mouth nearly all the time, continuing its use for a long time."

One notable fact emerges when Lincecum's early nineteenth century list of Choctaw medicinal plants is compared with lists of the twentieth century. Only one plant, *Cephalanthus occidentalis*, is found in the later lists (Bushnell, 1909, p. 24), and it is reported as used for sore eyes and toothache, not for dysentery, as indicated by Lincecum. The recent lists of plants and their uses do not show a very large number of correspondences, which is probably best explained by incompleteness of data and by individual and local group variation. But the correspondences between nineteenth-century lists and recent lists are practically nonexistent. It thus appears that Choctaw herbal medicine changed considerably during the hundred-year period and that the plants in use in more recent times are not especially representative of those used in aboriginal times. This conclusion is also supported by the plaintive remark of the Sixtowns Choctaw doctor in the early 1830's about the lack of interest in medicinal plants among his own people.

Lincecum mentions no plants that were used as emetics, an absence that agrees with all later lists. The Choctaw are said to have induced vomiting by inserting a finger or a feather in the throat (Swanton, 1931, p. 233; Taylor, 1940, p. 70). Taylor (1940, p. 70) has called attention to the absence among the Choctaw of any plants effectively used as antiperiodics and counterirritants. Lincecum's data do not conflict with this observation.

Some uses of these plants by the Choctaw are either unique or of rare occurrence in the Southeastern area. According to Lincecum, the Choctaw used the sap of *Vitis aestivalis* to induce lactation, which is the first report from the Southeast of a plant used as a lactagogue. The same is true regarding *Polygonum aviculare*, a decoction of which Choctaw women used to prevent miscarriage. The Choctaw used *Galium boreale* as a contraceptive, a usage that thus far has been reported only among the Cherokee, who used *Cicuta maculata* for this purpose (Mooney and Olbrechts, 1932, pp. 117–118; Olbrechts, 1931, p. 19). Olbrechts (ibid.) has stated his belief that the use of *Cicuta maculata* as a contraceptive among the Cherokee was probably derived from European settlers. He cites the resemblance of *Cicuta maculata* to parsley, especially in the early growth phase, and points out that parsley is still popular as an abortive in several European countries. The use of *Galium boreale* by the Choctaw suggests that herbal contraceptives may have been aboriginal in the Southeast.

### CHICKASAW

At present very little is known about Chickasaw medicinal plants. Adair (1775, pp. 122, 164–167), writing in the latter part of the eighteenth century, refers to only two medicinal plants that can be attributed safely to the Chickasaw Indians. Swanton (1928a, pp. 266–268) has published a list of 25 medicinal plants he obtained from a Chickasaw doctor in Oklahoma sometime between the years 1915 and 1924. Most of these plants are identified by Chickasaw names, and sixteen are also identified by common English names. Taylor (1940, *passim*) has assigned scientific names to eight of the latter. To Swanton's list may be added the following six plants reported by Lincecum:

*Botrychium virginianum* (L.) Sw., Virginia grape-fern. "Chickasaw name: *hoeta hocksish*,

puke weed [Choctaw: *hoeta*, vomit; *hakshish*, root]. Emetic, diaphoretic, expectorant. I saw a Chickasaw Indian using the decoction of the root of this plant for an emetic; it operated finely. After the operation was over, he took some Tomfulla water [liquid from a pot of hominy] and said, 'I was sick but I am now well.' "

*Heuchera americana* L. See Choctaw list.

*Chaerophyllum procumbens* (L.) Crantz, spreading chervil. "Chickasaw name: *shuah hokshoop*, stinking root [Choctaw: *shua*, stinking; *hakshup*, bark, husk, etc.]. The root. Emetic, poisonous. The Chickasaw use this article as an emetic, and it seems to operate very kindly, carrying off the morbid very well, always giving relief to the patient very similar to the lobelia."

*Dasystoma pedicularia* (L.) Benth., fern-leaved false foxglove. "Anti-scorbutic, emetic. The Chickasaw Indians use this plant for an emetic. It resembles in its action the lobelia. The Chickasaw use it with impunity."

*Eupatorium ageratoides* L. f. See Choctaw list.

*Verbesina virginica* L., Virginia crownbeard. "Deobstruant, stimulant, diuretic, antivenereal. A tea of the root of this plant, is, with the Chickasaw Indians, a very certain cure for Fluor Albus, and in almost all cases of uterine weakness . . . I found the Chickasaw Indians using this article 20 years ago. This article was written in 1846, after experimenting with it."

Lincecum's list of six Chickasaw medicinal plants does not appear to duplicate in any way the 25 plants on the Swanton list. Adair's two eighteenth century Chickasaw medicinal plants do not appear on Swanton's list either. As in the case of the Choctaw, it seems that there has also been much change in Chickasaw materia medica since the early nineteenth century. In a chart Taylor (ibid., p. 74) has indicated the absence of herbal emetics among the Chickasaw. Adair (1775, pp. 122, 164–167), Speck (1907b, pp. 55, 56), and Swanton (1928a, p. 268) all refer to specific ceremonial emetics, and Lincecum gives three additional plants used for this purpose.

## CREEK

Creek herbal medicine is much better known. In 1904–05 Speck (1907a, pp. 118–119, 124–133, 144) obtained a list of 17 medicinal plants from the Oklahoma Creek. Eleven of these are identified by scientific name, the remainder by English or Creek names. Swanton (1928b, pp. 639–663) has published data on 79 medicinal plants obtained from Creek informants in Oklahoma during the years 1911–12. Thirty-four of these plants are identified by scientific names; the others are identified by English and Creek names. Swanton calls attention to the fact that four of these plants are mentioned in late eighteenth century sources and that one is mentioned in an early nineteenth century source, but there are no correspondences in usage. Seven plants on the Speck list also occur on Swanton's list, but in only one instance are the uses similar. Taylor (1940, *passim*) has listed 29 Creek medicinal plants, most of which are derived from Swanton. To this we can add Lincecum's meager list of three plants:

*Persea pubescens* (Pursh) Sarg., swamp bay. "The root. Diaphoretic, hydragogue, alterant. The Muscogee, and nearly all the tribes of Southern Indians, use this article [a decoction] as a diaphoretic in fevers of all descriptions. It is also extensively used by them in dropsy. . . "

*Heuchera americana* L. See Choctaw list.

*Manfreda virginica* (L.) Salisb., false aloe. "The root. Mucilaginous. The root of this plant boiled in sweet milk and taken freely, or chewed and swallowed is a certain cure for the bite of the rattlesnake. I have known it done several times. It is a Muscogee remedy."

Of these three plants only *Manfreda virginica* appears on later lists (Swanton, 1928b, p. 645). The uses of this plant are approximately the same for both early nineteenth and early twentieth centuries, although Lincecum reports its use internally for snakebite, whereas Swanton indicates an external use. Among Lincecum's Choctaw, Chickasaw, and Creek plants, this is the nearest identity of both plant and use that occurs in early and late times.

## SUMMARY AND CONCLUSIONS

Twenty-two medicinal plants used by Choctaw, Chickasaw, and Creek Indians in the early nineteenth century have been identified on the basis of the actual plants in Lincecum's surviving medical herbarium and his recollections of their uses by these Indians. Of these, 16 were used by the Choc-

taw, 6 by the Chickasaw, and 3 by the Creek. Although divorced from myth and ritual, this list of plants and the accompanying data on usage add to our knowledge of folk medicine among these Muskhogean-speaking peoples.

Lincecum's list of 22 plants contains only 6 that have hitherto been reported for any specific Southeastern Indian group. Two of these have previously been reported for the same group—*Cephalanthus occidentalis* for the Choctaw, *Manfreda virginica* for the Creek. Only for the latter are the reported uses similar. The following five plants on Lincecum's list are now recorded for these Southeastern Indian groups: *Botrychium virginianum*, Chickasaw and Cherokee (Mooney and Olbrechts, 1932, p. 177); *Vitis aestivalis*, Choctaw, Creek (Swanton, 1928b, pp. 645, 660), and Cherokee (Mooney and Olbrechts, 1932, p. 660); *Eryngium aquaticum*, Choctaw, Alabama (Taylor, 1940, p. 45), Koasati (ibid.), and Cherokee (Mooney and Olbrechts, 1932, p. 245); *Cephalanthus occidentalis*, Choctaw (Bushnell, 1909, p. 24), Chickasaw (Taylor, 1940, p. 58), and Koasati (ibid.); *Verbesina virginica*, Chickasaw and Choctaw (Bushnell, 1909, p. 23). Identity of usage occurs only in the case of *Botrychium virginianum*, which both Chickasaw and Cherokee used for an emetic.

Two plants on Lincecum's Choctaw list were used for purposes not previously reported among Southeastern Indians—*Vitis aestivalis* to induce lactation and *Polygonum aviculare* to prevent miscarriage. The aboriginal use of herbal contraceptives in the Southeast, reported in recent times for the Eastern Cherokee and doubted by Olbrechts, may now be reexamined in the light of Lincecum's report of a similar use among the nineteenth century Choctaw.

Such evidence as we have—and the Lincecum record is about all that we do have—indicates that herbal medicine among the Choctaw of Mississippi and Louisiana changed markedly after the early nineteenth century. The principal changes were in plant species and their uses rather than in methods of drug preparation. It should be noted that these Choctaw did not remove to Indian Territory but remained in their aboriginal area. Although less evidence is available, similar and probably even more extensive changes occurred in Chickasaw and Creek medicine, for these two groups emigrated to a different natural environment. Few will doubt that much change did occur in the herbal medicine of all these people. The point is that heretofore very little concrete evidence of change has been available.

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# PALEONTOLOGY.—*Notes on* Phanocrinus cylindricus *and description of new species of Chester crinoids.*

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In this paper I present notes on the Fayetteville formation manifestation of *Phanocrinus cylindricus* and describe the following new species of Chester crinoids: *Eupachycrinus modernus*, *Aphelecrinus planus*, *Aphelecrinus exoticus*, and *Scytalocrinus aftonensis*.

Genus **Phanocrinus** Kirk, 1937

**Phanocrinus cylindricus** Miller and Gurley
Fig. 11

The species was well defined by Miller and Gurley (1894) and is readily distinguished from other described species by the full deep calyx and the 10 long, slow-tapering, uniserial arms. The surface of the dorsal cup was said to be granular. Horizon was given as "Kaskaskia group," of Pulaski County, Ky.

Kirk (1937) referred the species to *Phanocrinus* and has been followed by Sutton and Hagan (1939) and Sutton and Winkler (1940). The later authors described and figured a specimen of the Walker Museum collection as a syntype from the "Chester series of Pulaski County, Kentucky." They specified that no granulations were present.

Bassler and Moodey (1943) gave a more specific horizon for the species as "Chester-Glen Dean" but did not give a more specific locality.

The author considers it a matter worth recording that specimens readily identified as *P. cylindricus* have been collected from the Fayetteville formation, Chester, of Craig County, Okla., which decidedly show not only granulations on the surface of the cup plates, but also along the lateral sides of the axillary first primibrachials and the first secundibrachials. On the dorsal cup, granules are more prevalent on the RR and plates of the posterior interradius than elsewhere. On occasions the granules tend to become confluent and form irregular shaped narrow ridges. Apparently weathering, or possibly rolling about on the bottom of the ancient ocean, or both, had a tendency to obliterate the granulations except where protected along the impressed sutures and the lateral sides of the brachials. In many instances the granulations are difficult to discern except with the aid of low-powered magnification.

Two well-preserved crowns of *P. cylindricus* from the Fayetteville formation of northeastern Oklahoma are being deposited in the U. S. National Museum. The figured specimen was collected by Claude Bronaugh, of Afton, Okla.

Genus **Eupachycrinus** Meek and Worthen, 1865

**Eupachycrinus modernus**, n. sp.
Figs. 6–8

Dorsal cup is bowl-shaped, with broad basal concavity. Five small IBB are almost entirely covered by the large proximal columnal, but the triangular shaped extremities are visible. Five large BB form a good portion of the cup walls and curve sharply under to form also the sides of the basal invagination. Five large RR are slightly wider than long. Three large anal plates are present in the broad, mildly protruded posterior interradius. Anal X is hexagonal, with lower edge in broad contact with the truncated upper extremity of post. B. RA is pentagonal and lies obliquely on the right shoulder of post. B and a left facet of r. post. B. The hexagonal RX is directly above RA and to the right of anal X. All cup plates are tumid and are devoid of ornamentation.

First primibrachials are wide, axillary in all rays and fill the upper faces of RR. A second bifurcation takes place with the first secundibrachials in the anterior rays of the l. post. and r. ant. rami and in the posterior ray of the r. post. ramus. Both the left anterior and anterior rays have only two arms. In proximal portions of the arms the arrangement is uniserial but quickly becomes biserial. Delicate pinnules are present.

The proximal columnal has a mildly pentagonal outline and is pierced by a small pentalobate lumen. The anal sac is partially exposed and is small, round, composed of thin hexagonal plates, probably five to a circlet.

*Measurements in mm.*—As follows:

| | *Holotype* |
|---|---|
| Height of dorsal cup | 6.0 |
| Maximum width of cup | 13.5 |
| Length of l. post. B | 7.7[1] |
| Width of l. post. B | 6.2[1] |
| Length of interbasal suture | 4.7[1] |
| Length of l. ant. R | 4.6[1] |
| Width of l. ant. R | 7.0[1] |
| Length of interradial suture | 2.7 |
| Diameter of proximal columnal | 3.2 |

[1] Measurements taken along normal curvature of plates.

*Remarks.*—This species is different from normal representatives of the genus as interpreted by Kirk (1937) in several respects. Typical species have a second bifurcation of the arms in the right and left anterior rays, and in the anterior radius only two arms are developed. In *E. modernus* the second bifuraction is in the posterior ray and the left anterior radius is restricted to two arms. Another characteristic of normal *Eupachycrinus* is the unusual height of the basal concavity and a weakness of IBB plates disclosed by their normal absence. In the present species IBB are in place, albeit almost entirely covered by the proximal columnal, and the inner height of BB is 1.5 mm. lower than their outer height.

*Occurrence and horizon.*—Unnamed limestone formation below the Fayetteville formation, Chester, Mississippian; railroad cut about 3 miles southwest of Locust Grove, Okla.

*Holotype.*—Collected by the author. To be deposited in the U. S. National Museum.

Genus **Aphelecrinus** Kirk, 1944

**Aphelecrinus planus,** n. sp.
Figs. 9–11

Dorsal cup is low cone-shaped. The holotype is slightly distorted by lateral compression. Five IBB extend only slightly beyond the large, round columnar scar, and are upflared. Five BB are large and form a good portion of the calyx walls. They have a pentagonal outline but actually possess six sides with the exception of the posterior and right posterior which each have an extra facet for contact with plates of the anal interradius. Five RR are distinctive pieces. Outwardly directed articulating facets do not fill the width of RR and the outer faces of RR are extended along the interradial sutures to the innermost extremities of the plates. Posterior interradius is composed of three plates in normal (primitive) arrangement. All cup plates are unornamented.

There is an isotomous division of the long, slender arms in all rays on the somewhat elongate first primibrachials. Another bifurcation is known to occur in some rays at a considerable distance from the cup. Nonaxillary brachials are alternatingly extended as short spines so that one lateral side of each brachial is long and carries a stout pinnule, and the opposite side of the succeeding brachial is elongate and pinnular bearing.

Tegmen has not been observed.

*Measurements in mm.*—As follows:

| | *Holotype* |
|---|---|
| Length of crown | 55.5 |
| Height of dorsal cup | 4.3 |
| Maximum width of cup | 10.7[1] |
| Diameter of columnar scar | 2.4 |
| Height of l. post. B | 3.1 |
| Width of l. post. B | 3.2 |
| Length of interbasal suture | 1.7 |
| Height of l. ant. R | 2.7 |
| Width of l. ant. R | 4.2 |
| Height of l. ant. PBr | 4.9 |
| Width of l. ant. PBr | 4.0 |

[1] Distorted.

*Remarks.*—*A. planus* appears to be more closely related to *A. limatus* Kirk (1944) than other described species. The latter is a smaller species, with more exposed IBB plates, less ornate arm structure and less pronounced indentation of the interradial areas in the upper extremity of the cup.

*Occurrence and horizon.*—Approximately 5 miles southwest of Afton, Okla.; Fayetteville formation, Chester, Mississippian.

*Holotype.*—Collected by the author. To be deposited in the U. S. National Museum.

**Aphelecrinus exoticus,** n. sp.
Fig. 5

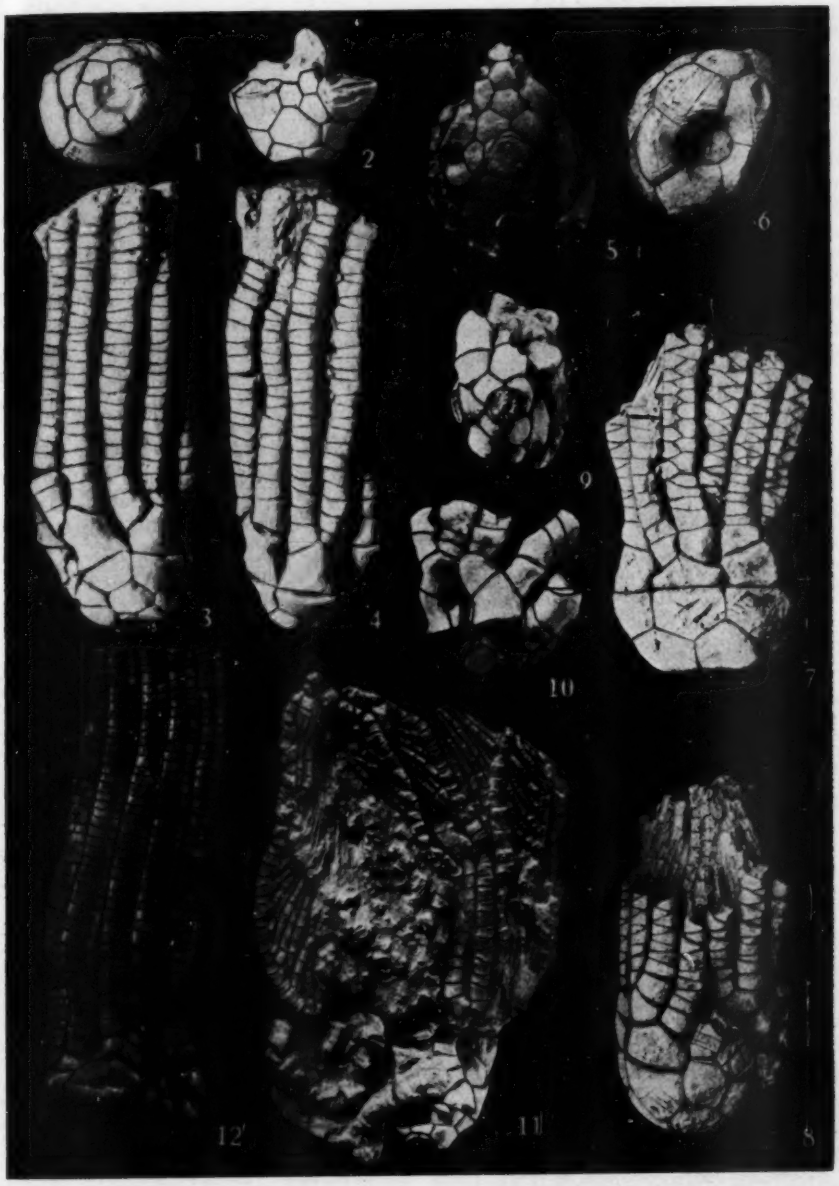
Dorsal cup is shallow, cone-shaped. Five IBB extend slightly beyond the large, round columnar scar and are upflared in attitude. Five BB are of modest size. Five RR are rather large. Articular facets are directed outwardly and fail to fill the distal faces of RR. Lateral sides of RR are curved sharply inward and recurve to form a flat narrow surface along the interradial sutures, which surface continues into the interarticular areas. Outer ligamental areas are strongly impressed, transverse ridges are prominent and intermuscular notch is pronounced. The muscle scars are shallow, lacking in definition. Three anal plates occupy the broad, protruded posterior interradius. Arrangement of these plates is normal (primitive) and RA is the most prominent. A small but well defined depression occurs at the proximal tip of each RR and extends into the interbasal areas. All cup plates are covered with narrow, irregular, elongated ridges or pustules.

Arms and tegmen have not been observed.

*Measurements in mm.*—As follows:

| | *Holotype* |
|---|---|
| Height of cup | 2.5 (distorted) |
| Width of dorsal cup (right post. anterior to left anterior radius) | 11.7 |
| Height of l. post. B | 2.5 |
| Width of l. post. B | 3.0 |
| Height of l. post. R | 2.7[1] |
| Width of l. post. R | 4.6 |
| Width of articulating facet | 3.6 |
| Diameter of columnar scar | 2.2 |

[1] To outer lip of ligamental furrow.




FIGS. 1–4.—*Scytalocrinus aftonensis*, n. sp.: 1, 2, Paratype from basal and posterior; 3, 4, holotype from right posterior and anterior, × 2. FIG. 5.—*Aphelecrinus exoticus*, n. sp.: Holotype from base, × 1.8. FIGS. 6–8.—*Eupachycrinus modernus*, n. sp.: Holotype from base, anterior and posterior, × 2. FIGS. 9–11.—*Aphelecrinus planus*, n. sp.: Holotype from base and anterior (Figs. 9 and 10 are enlarged × 1.8 and have been separated from the distal portions of the arms; Fig. 11 is × 1.4, showing the entire specimen). FIG. 12.—*Phanocrinus cylindricus* (Miller and Gurley): Left posterior view of specimen from the Fayetteville formation, × 1.8.

*Remarks.*—*A. exoticus* differs from other described species in the unusual depression of interradial sutures, dimplelike depressions at the proximal extremities of RR and in having spectacular ornamentation of cup plates.

*Occurrence and horizon.*—Approximately 5 miles southwest of Afton, Okla.; Fayetteville formation, Chester, Mississippian.

*Holotype.*—Collected by the author. To be deposited in the U. S. National Museum.

Genus **Scytalocrinus** Wachsmuth and Springer, 1880

**Scytalocrinus aftonensis,** n. sp.
Figs. 1–4

The crown is slender, long, and compact. Dorsal cup is truncate cone-shaped. Five IBB form a subhorizontal plane about the columnar scar with distal extremities curved upward to slightly participate in lateral walls of the cup. Five BB are wide, hexagonal except for posterior and right posterior BB, which each have an extra facet for contact with anal plates. Five RR are wide, pentagonal plates with subhorizontal articulating facets filling their distal faces. Outer ligamental notches are deep and wide. Transverse ridges are well defined and the muscle scars are moderately deep. Adsutural slopes are steep. The posterior interradius is rather narrow and the three relatively small anal plates are in normal (primitive) arrangement.

There are 10 cuneiform arms branching isotomously with the first primibrachial in all rays. The surfaces of the arms are well rounded, and there is no sharp angulation between the outer areas and the lateral sides. Each secundibrachial bears a pinnule.

The columnar scar is circular in outline, slopes strongly to the lumen and is heavily crenulated. The lumen appears to be pentalobate. The entire crown is devoid of ornamentation.

*Measurements in mm.*—As follows:

| | *Paratype* | *Holotype* |
|---|---|---|
| Height of dorsal cup | 6.5 | 4.5 |
| Maximum width of cup | 11.6 | 8.7 |
| Height of l. post. B | 2.8 | 2.5 |
| Width of l. post. B | 3.5 | 2.8 |
| Length of interbasal suture | 1.6 | 1.5 |
| Height of l. ant. R | 3.1 | 2.8 |
| Width of l. ant. R | 6.0 | 4.2 |
| Length of interradial suture | 2.2 | 2.0 |
| Diameter of columnar scar | 2.8 | 2.8 |

*Remarks.*—*S. aftonensis* is most readily separable from other described species in the nature of the IBB plates, which form a subhorizontal platform about the concave columnar scar, then flex sharply upward in distal portions to participate in the lateral calyx walls.

*S. validus*, the genotype species, has IBB that do not participate in the lateral cup walls and often the anterior ramus fails to bifurcate.

*Hypselocrinus* Kirk (1940) has upflared IBB, but they rise directly from the columnar scar. In the shape of the cup, therefore, the Fayetteville species appears to occupy an intermediate position between the two genera.

The irregular length of the axillary PBrBr is comparable to that found in *Apographiocrinus typicalis* Moore and Plummer as presented by the author (1938) under the name *Graphiocrinus carbonarius*. The height of these plates in mm is: l. ant. 3.8, l. post. 4.3, ant. 4.7, r. ant. 3.5, and r. post. 4.6.

*Occurrence and horizon.*—Approximately 5 miles southwest of Afton, Okla.; Fayetteville formation, Chester, Mississippian.

*Types.*—Collected by Mrs. Hazel Bronaugh, of Afton, Okla. To be deposited in the U. S. National Museum.

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## BOTANY.—*A new species of* Poa *from Peru.* JOHN R. REEDER, Yale University. (Communicated by Jason R. Swallen.)

In the spring of 1947 a small bundle of grasses was received from Dr. O. P. Pearson, now at the University of California. They were part of a collection of plants made by Dr. Pearson and his wife, in the region of Lake Titicaca in southern Peru. Among them were two collections of a species apparently undescribed. A description of this species is given below. Specimens are deposited in the Herbarium of Yale University, with duplicates in the United States National Herbarium and the Academy of Natural Sciences of Philadelphia. The type is at Yale.

**Poa pearsonii** sp. nov.

Perennis, dense caespitosa; innovationibus et basibus culmorum vaginis vetustioribus subcoriaceis fuscis vel fulvis dense vestitis; culmis erectis ad 50 cm altis gracilibus teretibus vel subcompressis scabris circiter 0.8 mm diametro, binodis, nodis in ¼ inferiore culmi sitis; vaginis artis quam internodiis plerumque longioribus subcompressis scabris; ligula lanceolata acuminata, 10–15 mm longa; laminis anguste linearibus involutis setaceis vel subjunceis, 0.8–1 mm diametro, eis innovationum culmis subaequalibus, eis summum culmi versus circiter 5–8 cm longis scabris sectione transversa ovalibus 7-nerviis, nervo mediano solo prominente; paniculis pyramidalibus subpatentibus, 10–12 cm longis, axi scaberula, ramis capillaribus nutantibus, inferiore 7–8 cm longo, ad ¾ longitudinis nudis, apicem versus spiculis instructis, ramis secundariis similibus sed solo ⅓–½ longitudinis nudis, omnibus 4–6-spiculatis, pedicellis brevissimis clavatis scabris; spiculis ellipticis confertifloris 5–6 mm. longis praecipue 3-floris (raro 2-floris), flore basali hermaphrodito, floribus superiorbus femineis cum staminodiis minutis (raro floribus omnibus femineis), rachillae internodiis brevissimis, flore secundo a basali vix separato; glumis acutissimis membranaceis laevibus, margine hyalinis; gluma prima 4–4.5 mm longa, uninervia, gluma secunda circiter 5 mm longa, quam flore contiguo paullo breviore; lemmatibus omnino similibus ovato-lanceolatis acutis, infimo 4.5 mm longo, superioribus decrescentibus, dorso et latere scaberulis,

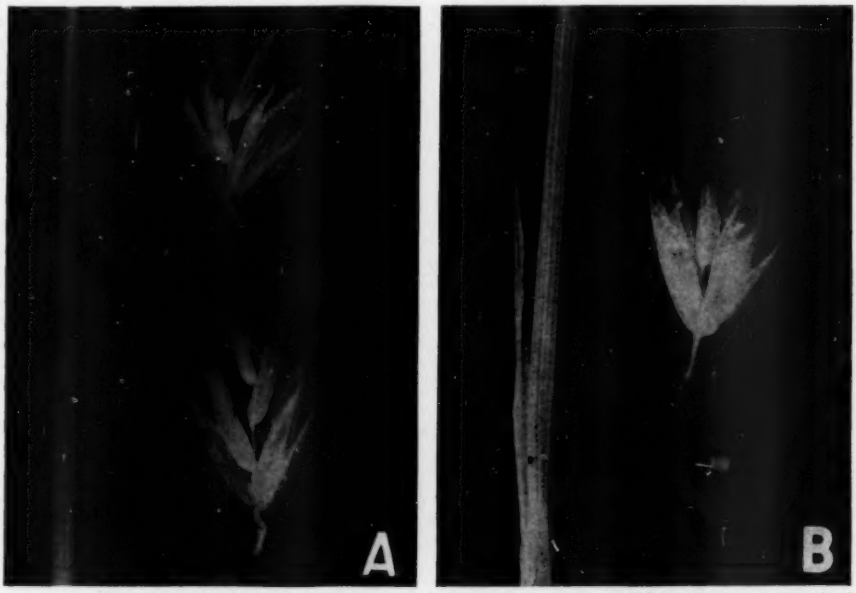



FIG. 1.—Ligules and spikelets, × 5: A, *Poa asperiflora;* B, *Poa pearsonii.* Note that in A the ligule is short, the lemmas are prominently nerved, and the florets are separated by rather long rachilla joints. In B, the ligule is very long, the lemmas are obscurely nerved, and the rachilla joint between the first and second florets is so short that these florets appear to be borne at about the same level.

5-nerviis, nervis lateralibus obscuris quam lemmate brevioribus, callo glabro, carina basim versus puberula; palea quam lemmate paullo breviore, minute bidentata, carinis scabris; antheris in flore basali circiter 3 mm longis.

DEPARTMENT OF PUNO: Cerro Ichuasi, Coccachara, southwest of Llave, alt. about 4850 m, *O. P. & A. Pearson 91* (TYPE), November 22, 1946 (growing in gravelly soil at bottom of cliffs and alongside boulders; plants erect, in clumps, 25–50 cm tall).

The new species is apparently closely related to *Poa asperiflora* Hack., the type of which was collected in Bolivia on Titicaca Island at somewhat lower elevations. It differs from that species in having a much longer ligule, 2-noded culms and 3-flowered (rarely 2-flowered) spikelets in which the rachilla joints are very short, the second floret being scarcely raised above the basal one, the joint between the second and third floret somewhat longer. In *P. asperiflora* the ligule is about 4 mm long, the spikelets are predominantly 4-flowered (rarely 3-flowered), and the florets are separated by distinct rachilla joints, these ¼–½ the length of the florets. A further difference is seen in the florets, those of *P. pearsonii* tending to be somewhat larger and with obscurely nerved lemmas. The lemmas of *P. asperiflora* are very prominently nerved.

A second collection, *O. P. & A. Pearson 93*, from about the same location as the type but on a dry slope, appears to represent the new species. The spikelets are identical except that the florets are pistillate rather than perfect. The leaves are all distinctly shorter than the culm, and the culm seems to be 1-noded rather than 2-noded as in the type.

I wish to thank Jason R. Swallen, head curator, Department of Botany, United States National Museum, who kindly lent a type duplicate of *Poa asperiflora* Hack., and who also examined the Pearson specimens and confirmed my opinion that they represent an undescribed species.

## ENTOMOLOGY.—*New species of Olethreutidae from Argentina (Lepidoptera).*

J. F. GATES CLARKE, U. S. Bureau of Entomology and Plant Quarantine.

The following species of olethreutid moths are described from specimens submitted by Dr. Kenneth J. Hayward, Institute Miguel Lillo, Tucumán, and Mr. Fernando Bourquin of Buenos Aires, Argentina. This is the fourth[1] in a series of papers dealing with Microlepidoptera from Argentina.

The photographs for this paper were taken by Robert Bonde, U. S. Department of Agriculture. Drawings by the author.

**Anchylopera plumbata,** n. sp.

Figs. 1, 7, 8.

Alar expanse, 11–13 mm.

Labial palpus with second segment greenish gray, with a sordid whitish transverse band exteriorly and a spot of the same color interiorly; apex of second and third segment rust color. Antenna rust color. Head, thorax, and ground color of forewing greenish gray; dorsal half of wing from base to tornus rich dark brown, the area narrower at base and tornus than at middle; entire costa marked with short, oblique, dark-brown streaks alternating with similar metallic ones; from center of costa an accentuated dark-brown streak continuing to and confluent with a narrow triangular dark-brown area, the latter bounded by a narrow metallic line; on costa, before apex, a white lunate streak; inner contour of apex and termen fuscous edged interiorly with a narrow, broken, white line; cilia from pale grayish in tornal area to fuscous at apex with the central portion metallic. Hindwing light brown; cilia slightly lighter. Legs whitish, the fore- and midlegs strongly suffused with fuscous.

*Male genitalia.*—As figured.

*Female genitalia,*—As figured.

*Type.*—U. S. N. M. no. 61080.

*Type locality.*—Tigre, Argentina.

*Remarks.*—Described from the type male and four male and female paratypes from the type locality, all reared by Fernando Bourquin, who will publish the life history. Paratypes in the U. S. National Museum and Mr. Bourquin's collection, Buenos Aires.

The pattern of *plumbata* is similar to many other species in this genus, but there are no known close relatives.

[1] *Notes on South American Tortricidae.* Acta Zool. Lilloana **7:** 579–588, 3 pls. 1949.

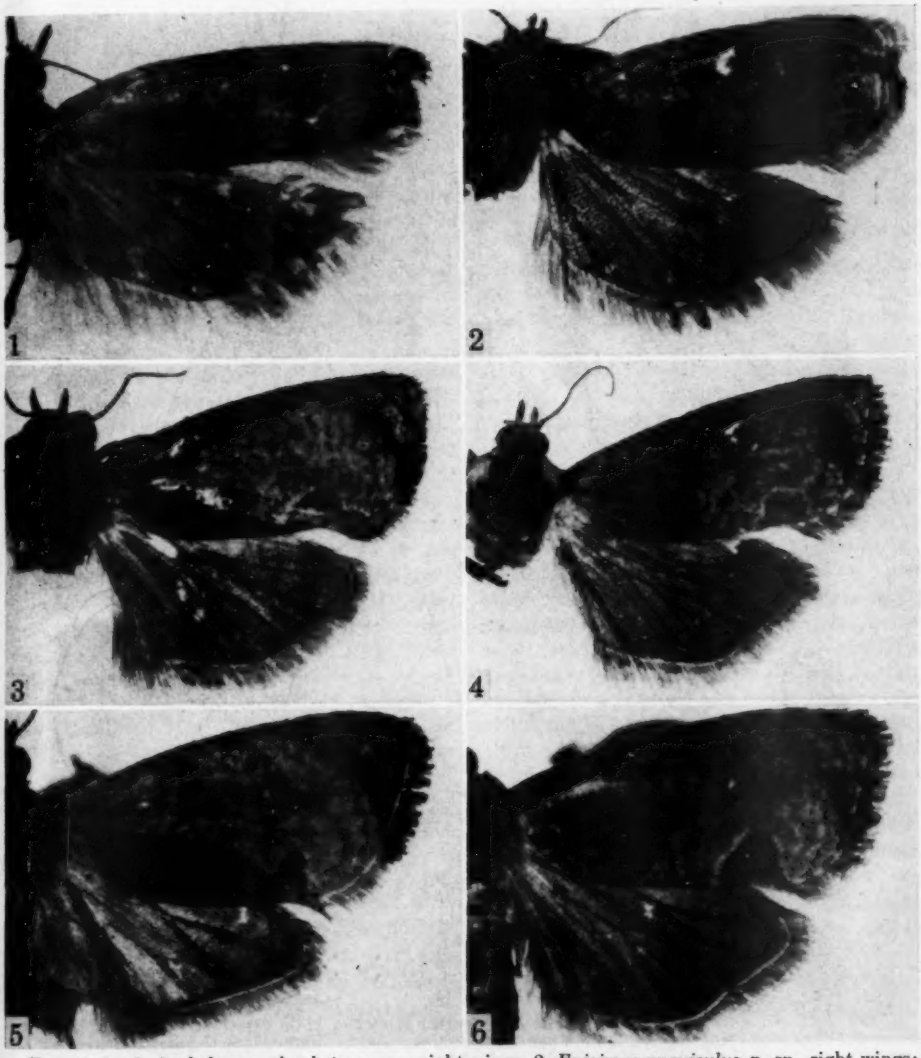
*Two new genera and three new species of Microlepidoptera from Argentina (Gelechiidae).* Journ. Washington Acad. Sci. **40:** 285–289, illus. 1950.

*New species of Gelechiidae from Argentina (Lepidoptera).* Journ. Washington Acad. Sci. **41:** 140–142, illus. 1951.

**Episimus unguiculus**, n. sp.
Figs. 2, 11, 12.

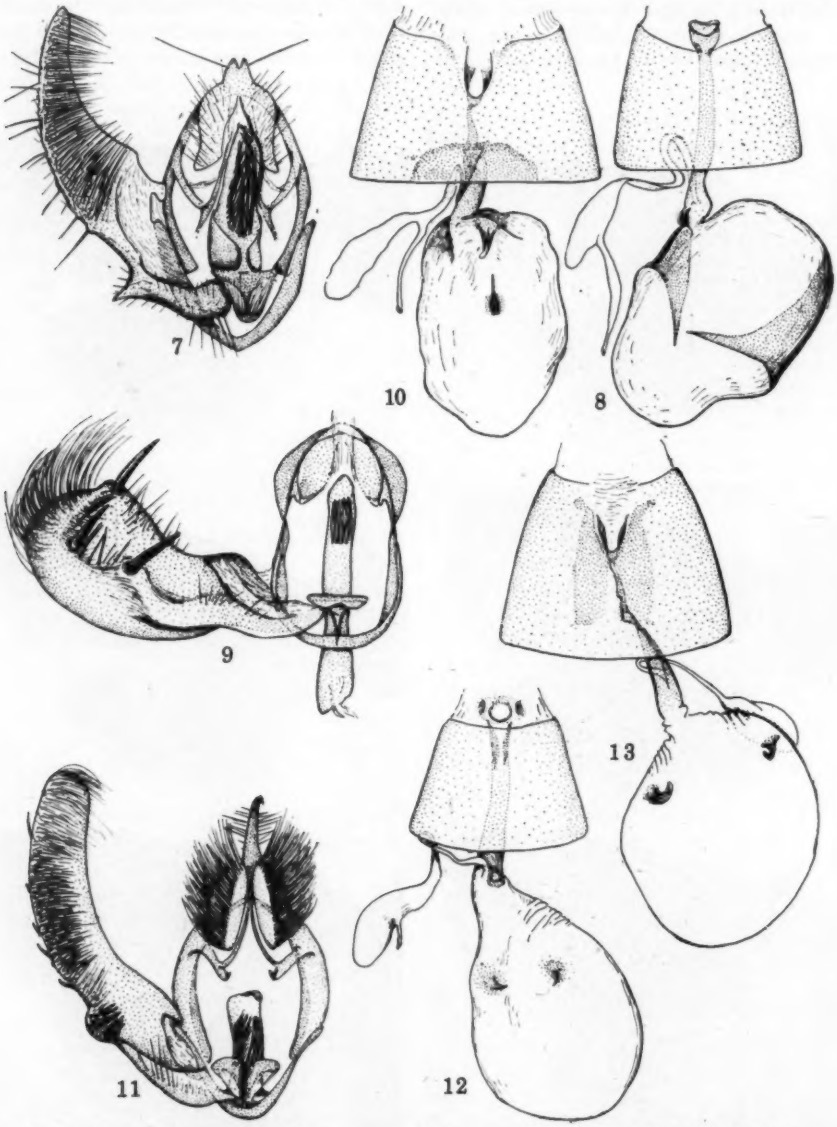
Alar expanse, 15–17 mm.

Labial palpus with second segment purplish fuscous basally, brownish distally; third segment purplish fuscous. Antenna fuscous, scape brown. Head mixed brown and purplish fuscous, gray posteriorly. Thorax brown anteriorly followed by a gray transverse band, the latter followed by brown and purplish fuscous mixed. Forewing with purplish-fuscous ground color crossed basally with obscure brown, transverse lines; costa, from base to slightly before middle, marked with small fuscous spots; from slightly before middle of costa to apex a series of leaden-metallic, tawny-edged, oblique streaks, the second, third, and




FIGS. 1–6.—1, *Anchylopera plumbata*, n. sp., right wings; 2, *Episimus unguiculus*, n. sp., right wings; 3, *Cryptophlebia carpophagoides*, n. sp., right wings of male; 4, same, right wings of female; 5, *C. carpophaga* Walsingham, right wings of male; 6, same, right wings of female.

fourth confluent and continuing as a single streak to termen just below apex; alternating with the metallic streaks narrow triangular fuscous spots along costa; from dorsum, before middle, a fuscous line extending toward fold where it broadens into a rectangular, tawny-edged, fuscous patch; at outer third a fuscous shade, mixed with tawny scales, extending from tornus to middle of wing where it broadens and then becomes attenuated toward costa and apex; this shade followed by a




FIGS. 7–13.—7, *Anchylopera plumbata*, n. sp., ventral aspect of male genitalia with right harpe removed; 8, same, ventral view of female genitalia with ovipositor removed; 9, *Cryptophlebia carpophagoides*, n. sp., ventral view of male genitalia with right harpe removed; 10, same, ventral view of female genitalia with ovipositor removed; 11, *Episimus plumbata*, n. sp., ventral view of male genitalia with right harpe removed; 12, same, ventral view of female genitalia with ovipositor removed; 13, *Cryptophlebia carpophaga* Walsingham, ventral view of female genitalia with ovipositor removed.

transverse band of leaden-metallic scales, the latter followed by tawny; at upper angle of cell a leaden-metallic spot bounded by white; ocelloid area consisting of two short, black longitudinal dashes followed by a small transverse patch of silvery-metallic scales; the silvery-metallic patch bounded exteriorly by white scales; cilia tawny except those opposite veins 3–5, which are leaden. Hindwing fuscous; cilia light fuscous except those between vein two and apex, which are tawny with a light fuscous subbasal band. Legs ocherous-white strongly suffused and banded with fuscous.

*Male genitalia.*—As figured.

*Female genitalia.*—As figured.

*Type.*—U. S. N. M. no. 61082.

*Type locality.*—Tigre, Argentina.

*Remarks.*—Described from the type female and three male and female paratypes (the paratypes are in poor condition), from the type locality and all reared by Fernando Bourquin, who will publish the life history. Paratypes in the U. S. National Museum and Mr. Bourquin's collection, Buenos Aires.

This and the North American species *E. argutanus* (Clemens) are very closely related. The harpe of *unguiculus* is broader and more robust, and the spine cluster is nearly twice as large as that of *argutanus*. The female genitalia demonstrate extremely close affinity, the chief difference being that the ostium of *argutanus* is rectangular. The color and markings of the two are strikingly similar, but *unguiculus* differs from *argutanus* by the strong dorsal mark, the tawny terminal area, and the reduction of the white scaling before termen.

**Cryptophlebia carpophagoides**, n. sp.

Figs. 3, 4, 9, 10

Alar expanse 20–24 mm.

Labial palpus brownish buff to fuscous usually edged with blackish fuscous above. Antenna fuscous with slightly paler, narrow annulations. Head and thorax brownish buff to blackish fuscous; tegula warm buff to grayish buff, apex blackish fuscous. Forewing light grayish buff; in male costa suffused with fuscous with faint suggestion of alternating small fuscous and semimetallic spots; from costa at four-fifths a slightly curved fuscous line, mingled with black and semimetallic scales, extending to slightly beyond middle of termen, this line less pronounced in the female; between this line and apex two obscure, short brownish lines; dorsum blackish fuscous from base to middle; on tornus a short, oblique black dash, more pronounced and larger in female than in male and edged with brown below and above in female; apical half of ground color sparsely irrorate with black. In the female the whole pale ground color obscured by brown and dark fuscous with a patch of gray-tipped scales before the tornal dash, and dull leaden patches scattered in apical half; cilia leaden. Hindwing fuscous, paler basally; cilia pale fuscous with darker subbasal line. Legs buff more or less suffused and banded with fuscous. Abdomen brownish above, buff beneath suffused with fuscous.

*Male genitalia.*—As figured.

*Female genitalia.*—As figured.

*Type.*—U. S. N. M. no. 61081.

*Type locality.*—Tucumán, Argentina.

*Food plant.*—Seeds of "pacará."

*Remarks.*—Described from the type male and six male and female paratypes from the type locality, all reared by Dr. Kenneth J. Hayward of Tucumán. Emergence dates are not indicated on the pin labels. Paratypes in the U. S. National Museum and the Instituto Miguel Lillo, Tucumán, Argentina.

This is the first record of the occurrence of the genus *Cryptophlebia* in the New World, and, although this species differs in several respects from the type of the genus, *C. carpophaga* Walsingham, there is no doubt about the relationship.

The male genitalia of both species are strikingly similar, and both bear the three large, strong setae on the harpe, as figured, but *carpophaga* lacks the smaller setae *between* the three large ones. In the female of *carpophagoides* there is a strongly sclerotized area on the anterior edge of the seventh sternite, but in *carpophaga* (Fig. 13) it is longitudinal and divided as illustrated. Female genitalia figured from a Guam specimen.

The male of *carpophagoides* lacks the specialized sex-scaling of the hindwing found in *carpophaga* and also lacks the ridge of long dorsal hairlike scales of the abdomen; also the tufting of the hindleg is less pronounced in *carpophagoides* than in *carpophaga*. Both species feed in the seeds of their hosts.

NOTE

In my article *New species of Gelechiidae from Argentina (Lepidoptera)*, Journ. Washington Acad. Sci. **41**: 140, 1951, I omitted the type locality for *Parastega hemisigna* Clarke, which should have been given as "Tigre, Argentina."

# ENTOMOLOGY.—Ficalbia minima (*Theobald*) *in South Indochina, with descriptions of the larva and pupa* (Diptera: Culicidae).[1]

HARRY D. PRATT. (Communicated by C. W. Sabrosky.)

About 25 years ago Dr. Émile Borel began a mosquito survey of South Indochina, which culminated in the publication of his monograph "Les Moustiques de la Cochinchine et du Sud-Annam." Although Borel reported some 89 species and 16 genera of mosquitoes from South Indochina, neither he nor later French entomologists appear to have collected mosquitoes in the genus *Ficalbia* in South Indochina. Similarly neither Barraud (1934) nor any of the World War II mosquito control workers appear to have figured all stages of *Ficalbia minima* (Theobald), the type species of the genus *Ficalbia*, although Iyengar (1935) and his coworkers did collect and rear all stages of this mosquito in India. *F. minima* is reported from India, Assam, Borneo, and Hong Kong by Barraud (1934) and from Tonkin (or North Indochina) by Galliard and Ngu (1949). The finding of *minima* at Saigon now extends its southeastern distribution considerably. The present paper gives a description of the pupa, which hitherto was undescribed, together with a redescription of the larva and notes on the breeding habitat.

*Pupa.*—The pupa of *F. minima* is quite distinct from the other species in the genus. The pupal trumpet (Fig. 1, F) is normal, with a cleft on one side slightly more than halfway to the base. It is not modified at all for piercing the roots of aquatic plants to obtain air as in *Ficalbia chamberlaini*. Unlike most species in the genus, the first segment of the abdomen (Fig. 1, G) has a well-developed pair of dendritic tufts or "float hairs." The paddles at the tip of the abdomen have the usual spines along the lateroposterior margin. The paddles are of rather normal shape, not long and narrow as the *Ficalbia fusca* or *Ficalbia luzonensis* (cf. figures 24b, c, e, and g in Barraud, 1934).

*Larva.*—The larva of *F. minima* is very distinct on a number of characters. The preclypeal spines of the head (fig. 1, A, B) have a number of fine denticles at the base, a character found in only a few other mosquito larvae, such as *Aedes* (*Howardina*) *walkeri* Theobald, and certain other species of mosquitoes breeding in bromeliads. The antenna (Fig. 1, A) is rather unusual in having the two long subapical hairs placed a considerable distance from the tip of the antennal shaft. In this respect the antenna is rather intermediate between the antenna of a typical *Culex* and a typical *Mansonia*. The air tube (Fig. 1, D) has the hair tuft inserted near the base rather than near the middle as in the other species of *Ficalbia*. This causes the species to run to *Theobaldia* or *Hodgesia* in the key of Barraud (1934, p. 33) even though the larva agrees in all other significant details with Barraud's figure of *minima*. There are only two pecten spines on the air tube itself (Fig. 1, D, E) and six comb scales. The comb scales (Fig. 1, C) of the Saigon specimens do not show the fine lateral denticulation of Barraud's figure (1934, fig. 27C). The Saigon specimens therefore agree better with the specimens from Tonkin reported by Galliard and Ngu (1949) in having smooth comb scales than they do with those from Hong Kong described by Barraud (1934) which have the comb scales with fine lateral denticles.

*Biology.*—On November 23 and 24, 1950, larvae and pupae of *F. minima* were found in the Botanical Garden in Saigon, Indochina, by the author and Dr. Le Du. The larvae were found in a densely shaded pool of cool, clear water containing large amounts of submerged aquatic vegetation, which appeared to be *Ceratophyllum* and floating duckweeds similar to *Lemna*. No waterlettuce (*Pistia*) was in the pool, although Iyengar (1935) and Galliard and Ngu (1949) have reported that in India and in Tonkin this species is found only in pools with that plant. They attributed this restricted habitat to the fact that *F. minima* lays its eggs on parts of the leaves of *Pistia* that overhang the water surface. The larvae were not abundant, averaging about one in every ten dips. Associated mosquito larvae were *Anopheles barbirostris*, *Culex* (*Mochthogenes*) *malayi*, and a species of *Culex* near *vishnui*. None of the larvae could be reared to the adult stage, but two of the pupae produced females that agree with the description of *F. minima* in Barraud (1934).

[1] From the Communicable Disease Center, Public Health Service, Federal Security Agency, Atlanta, Ga.

ACKNOWLEDGMENTS

The collections in Saigon were made while the writer was assigned as a malaria consultant with the Special Technical and Economic Mission to Vietnam of the Economic Cooperation Administration. He wishes to acknowledge the kind assistance of Dr. H. Marneffe and M. P. Martin, of the Pasteur Institute of Saigon, for the privilege of working in their excellent library and laboratory. Dr. Alan Stone, of the U. S. Bureau of

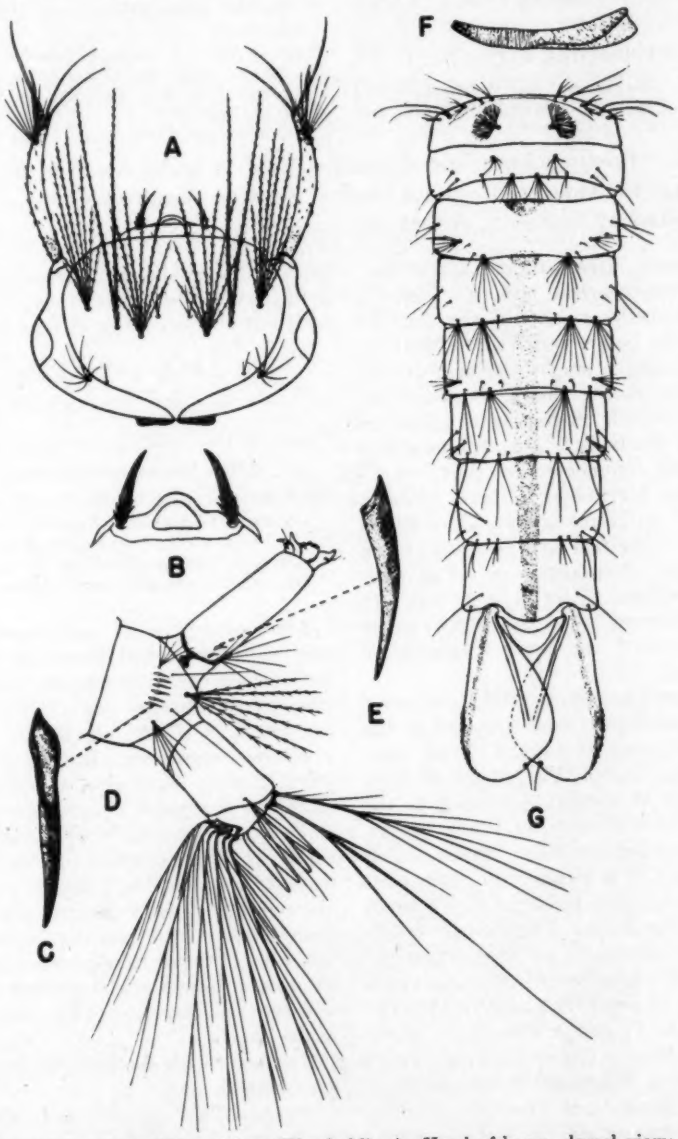



FIG. 1.—Structures of *Ficalbia minima* (Theobald): A, Head of larva, dorsal view; B, preclypeal spines of larva, dorsal view; C, comb scale of eighth abdominal segment, larva; D, terminal abdominal segments of larva; E, pecten tooth of arva; F, pupal trumpet; G, abdomen of pupa.

Entomology and Plant Quarantine, has checked the determination of the adult female and larva of *F. minima*. One adult, one pupa, and one larva have been deposited in the collections of the U. S. National Museum and the Communicable Disease Center, Atlanta, Ga. The drawings were made by C. J. Stojanovich.

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# ZOOLOGY.—Bostrichobranchus digonas, *a new molgulid ascidian from Florida*.

DONALD P. ABBOTT, Hopkins Marine Station, Stanford University. (Communicated by Fenner A. Chace, Jr.)

The common American east-coast ascidian *Bostrichobranchus pilularis* (Verrill), 1871, has a single gonad, situated on the left side of the body. Van Name (1921) reported examining a single specimen of this species, taken in St. George Sound, Fla., which was "unique in having a gonad on each side of the body." This unique specimen has been commented on (but not reexamined) by Hartmeyer (1923), Ärnbäck (1928), and Van Name (1945), all of whom have regarded it either as a reversion to an ancestral 2-gonad condition or as an individual aberration. Were it not for new evidence, presented below, the present writer would concur with the above treatment of this specimen.

Recently an opportunity arose to examine a series of specimens found stranded on the sandy beach along the Peace River estuary, Charlotte Harbor, Fla., about 20 miles from the Gulf of Mexico. According to the collector, J. C. Galloway, of Punta Gorda, Fla., the stranded ascidians formed a belt on the shore 4 to 6 inches wide and about 100 yards long, and included many thousands of individuals. Twenty-one specimens of the collection, as well as supplementary and comparative materials, were placed at my disposal for study through the kindness of Dr. Fenner A. Chace, Jr., of the Division of Marine Invertebrates, United States National Museum. Investigation of the 21 individuals from Charlotte Harbor, all of which bore two gonads, and re-examination of Van Name's unique specimen from St. George Sound show that these ascidians represent a previously undescribed species of *Bostrichobranchus*, closely related to *B. pilularis* but unequivocally distinct from it.

### Class ASCIDIACEA

### Order STOLIDOBRANCHIA

### Family MOLGULIDAE Forbes and Hanley, 1848

**Bostrichobranchus digonas,** n. sp.

*Bostrichobranchus pilularis* Van Name, 1921, p. 478 (only the specimen from St. George Sound, Fla., with a gonad on each side of body); 1945 p. 441 (only the specimen from St. George Sound, Fla., with a gonad on each side of body).

*Dimensions.*—For 12 well-expanded, turgid specimens the external dimensions of the tunic (here, as elsewhere, the mean is followed by the range in parentheses) were: Height 17 (12–20) mm; length 18 (15–20) mm; width 7 (4–10) mm.

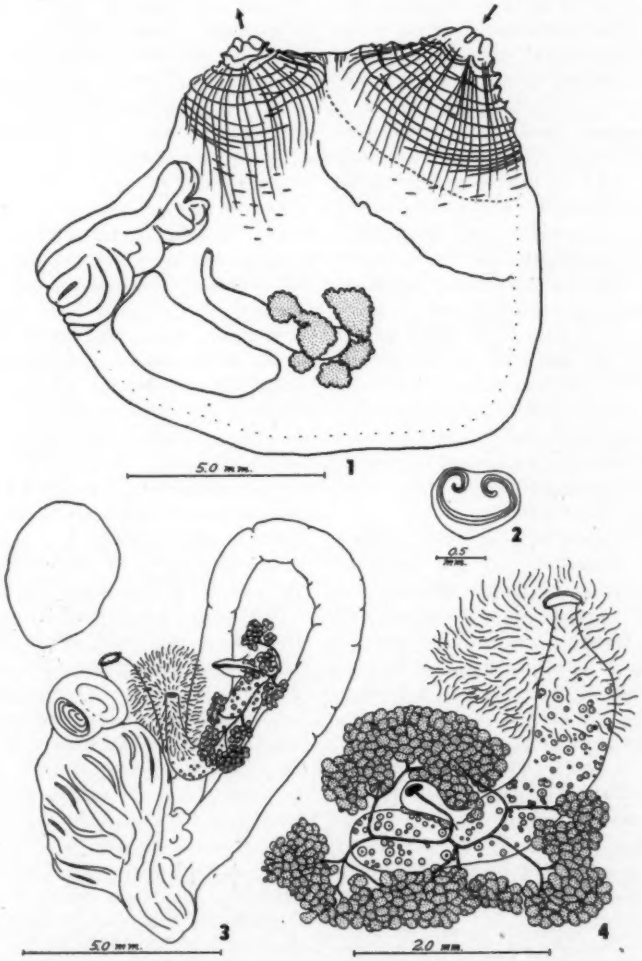
*External appearance.*—Body oval and somewhat laterally compressed, the siphons rather short and contracted in most specimens; tunic almost completely free of sand, mud, and other debris, its surface relatively smooth and bearing scattered small tendrils, or minute papillae probably representing broken tendrils (specimens were washed ashore and probably somewhat worn externally); tunic membranous and free of wrinkles in most areas, somewhat thicker and bearing circular wrinkles on and about the bases of the siphons.

*Apertures.*—Oral aperture with six lobes, atrial aperture with four.

*Mantle.*—Thin, delicate, and transparent in most areas; muscle fibers arranged into conspicuous bundles only on the siphons, where they constitute the radial and circular muscles (Fig. 1);

radial or siphon retractor muscles consist of stout bundles running along the siphons to terminate at or slightly below their bases; a single individual out of 22 examined bore radial muscles grouped into thick bands corresponding with the lobes of the apertures; circular or siphon constrictor muscles present, these, when contracted, creating one or more distinct circular grooves around each siphon; a short series of transverse bundles overlies the dorsal intersiphonal area; occasional bundles occur elsewhere, laterally and ventrally, but these are generally so small, few in number, widely separated, and inconspicuous as to be easily overlooked.

*Tentacles.*—Compound to branches of the third order on the largest tentacles; two-thirds of 18 individuals examined showed only three orders of tentacles, one-third possessed small fourth order tentacles as well; total numer of tentacles, counting all four orders = 23 (17–34), counting only three orders = 20 (13–29); basic number of tentacles of each order apparently either 5-5-10 or 6-6-12, the alternatives appearing in about equal numbers; distribution pattern basically




FIGS. 1–4.—*B. digonas*, n. sp.: 1, With the tunic removed, viewed from the right side; 2, dorsal tubercle; 3, medial view of digestive tract, left gonad, and atrial aperture; 4, medial view of right gonad.

-1-3-2-3-1- where three orders are present, and -1-4-3-4-2-4-3-4-1- where four orders occur; regularity of this pattern varies from perfect to rather poor, but pattern is regular in at least parts of the tentacular rings of all specimens.

*Dorsal tubercle.*—In 21 specimens examined the aperture was a U-shaped slit, with the horns sufficiently inrolled to form approximately a full circle at either end of the slit (Fig. 2); open interval directed anteriorly and usually inclined slightly toward the left.

*Dorsal lamina.*—Rather narrow anteriorly, gradually broadening posteriorly and passing some distance to the left of the esophageal opening to terminate near the "hepatic" region of the stomach; free margin smooth or slightly undulating; internal longitudinal vessels of the left side curve medially and join the base of the lamina.

*Pharynx.*—Without folds, but always with seven ribbonlike internal longitudinal vessels and five transverse vessels on each side; pharyngeal wall bearing many spirals varying from small, flat coils to very elongate, conical infundibula; each infundibulum composed of two uninterrupted, spirally intertwined stigmata separated at the apex; each stigma on the more elongate infudibula coiled six to eight turns; spirals generally about 15 (7–29) per mesh for the central fields between fifth and seventh internal longitudinal vessels (based on 85 fields counted in 17 specimens); infundibula numerous and irregularly distributed in all individuals examined, making it very difficult to distinguish primary and accessory spirals with any certainty.

*Digestive tract.*—Esophageal aperture situated about halfway posteriorly on the pharynx; esophagus short; stomach in two divisions, an upper globular portion communicating with esophagus and intestine and bearing seven or eight doubled and somewhat irregular folds as seen from its medial surface, and a lower portion, twisted posteriorly to form a small, blind "hepatic" sac ventral to the main gastric chamber; intestine forms a rather small, open primary loop, the descending limb returning to contact the proximal intestine and the rectum rising in contact with the stomach; rectum terminates near the branchio-esophageal junction in an anus whose margin bears numerous small and often irregularly distributed teeth.

*Renal organ.*—Bean-shaped, lying posteroventral to the gonad on the right side, its posterior end contacting the stomach wall.

*Gonads.*—Each of the 22 specimens examined bore a complete set of reproductive organs on each side of the body, the left gonad lying largely in the primary intestinal loop (Fig. 3); ovary on either side tubular in outline, narrowing at its posterior end into a short oviduct directed toward the atrial aperture; inner surface of mantle in the vicinity of the oviducal aperture bears a conspicuous circular path of delicate tendrils (Figs. 3, 4) probably aiding in the retention of eggs and embryos which are brooded in the atrial cavity; male glands arranged about the margin of each ovary, in a series of two to twelve clusters of lobulate testes; clusters may be clearly separated or sufficiently closely placed to form a more or less continuous border about the more anterior portions of each ovary; efferent ducts from each cluster of testes join those of adjacent clusters and run centripetally to the base of the single, large common spermatic duct which rises from near the center of the medial wall of each ovary to project freely as an erect, elongate, finger-like process into the atrium (Figs. 3, 4); in a single specimen the common spermatic duct of the left side was bifurcate; eggs present in the atria of all specimens from Charlotte Harbor (collected January 29, 1938), lying free or enmeshed in the mantle tendrils about the oviduct; eggs encased within 12- or 14-sided polyhedral membranes (whether this shape is natural or the result of preservation is uncertain); diameter of egg within polyhedral casing 0.19 (0.17–0.21) mm; atria in a few individuals contain embryos and other stages up to young prefunctional oozooids; tadpole stage absent in development.

*Specimens examined and compared* (all deposited in the U. S. National Museum), as follows:

*B. digonas:* 1 type and 20 paratypes, found stranded on the beach along the Peace River estuary, Charlotte Harbor, Fla., about 20 miles from the Gulf of Mexico, roughly at lat. 26°58′ N., long. 82°02′ W., U.S.N.M. nos. 10976 (holotype) and 10977–10978 (paratypes). One specimen, from St. George Sound, Fla., U.S.N.M. no. 7242 (this is the specimen with two gonads referred to by Van Name, 1921 and 1945).

*B. pilularis:* 11 specimens, from off Marthas Vineyard, 63 fathoms, U.S.N.M. no. 4940. Seven specimens, from Long Island Sound, 8 fathoms, U.S.N.M. no. 5014. One specimen, from off northwest end of St. Martins Reef, Florida banks, near lat. 28°50′ N., long. 83° W., U.S.N.M. no. 7229. One specimen, from off Georgia, 10 fathoms, lat.

| *Feature* | *B. digonas* | *B. pilularis* |
|---|---|---|
| Mantle musculature | Muscle bundles absent laterally and along endostyle, or if present very sparse, weak, and inconspicuous. | A row of short, stout, numerous, and conspicuous muscle bundles present on each side of body along endostyle and running at right angles to latter; a series of short muscle bundles running parallel with the circular muscles of the siphons extends downward on each side of body from atrial siphon. |
| Dorsal tubercle | With the horns of the slit inrolled approximately one full turn at each end. | With horns of the slit not incurved save in large individuals, and here not inrolled a full turn at each end. |
| Gonads | Always present on both sides of body. | Present only on left side of body. |
| | Anterior closed end of left ovary reaching only half to two-thirds of the way up to inner peak of primary intestinal loop. | Anterior closed end of left ovary reaching to, or almost to, inner peak of primary intestinal loop. |
| | Testes usually arranged in separate clusters; these are sometimes closely apposed to form a more or less continuous series about the more anterior portions of oviduct. | Testes arranged in a continuous row about whole margin of ovary, never grouped into distinct clusters. |
| | Inner surface of mantle surrounding oviducal aperture bearing a conspicuous circular patch of fine tendrils. | Mantle in area adjacent to oviducal aperture smooth and unmodified. |
| | Efferent ducts from clusters of testes run centripetally and unite to form a single, erect, fingerlike common spermatic duct projecting freely into atrial cavity on each side. | Efferent ducts from testes extend across tubular ovary to join a long common spermatic duct, which runs prostrate along whole length of ovary and lies embedded in its medial wall; along its length this common duct bears about 10 (7–15) minute papillae, each of which terminates in an aperture for the discharge of sperm. |

32° N., long. 80°25′ W., U.S.N.M. no. 10501.

*Specific diagnosis.*—The specific features distinguishing *B. digonas* from *B. pilularis*, the only other member of the genus, are tabulated above. In nearly all other respects, and particularly in regard to the detailed structure of the pharynx, the two species are so similar as to be nearly indistinguishable. The majority of differences concern the gonads, and the simplest method of distinguishing the species is by the presence or absence of a gonad on the right side. Both species have direct development without a tadpole larva.

*Discussion.*—*Bostrichobranchus* belongs to a small group of molgulid species sometimes called "eugyrids," which have the following characters in common: a branchial sac lacking folds, and bearing five transverse vessels and five to seven ribbonlike internal longitudinal vessels on each side; a branchial wall bearing large spirals, often infundibulate, each of which is formed by two intertwined stigmata which are uninterrupted throughout their entire lengths but are generally separated apically; the left gonad, when present, is always placed largely or wholly in the primary intestinal loop. Attempts to subdivide this group into genera have centered around two features: the number and position of the gonads, and the presence and degree of development of secondary spirals on the pharynx.

On the basis of the number and location of the gonads alone, three eugyrid genera are sometimes recognized: *Gamaster*, with a single gonad on the right side of the body; *Eugyra*, with a single

gonad on the left side; and *Eugyroides*, with two gonads, one on each side of the body. Hartmeyer (1911), Huntsman (1922), and Ärnbäck (1928) recognized all three genera. Huus (1937) recognized the three groups as subgenera under the genus *Eugyra*. Michaelsen (1915), Hartmeyer (1923), and Van Name (1945) united the three genera under *Eugyra*. (Van Name, 1945, actually made no mention of *Gamaster*, but by implication this group would not receive generic status in his classification.) Michaelsen (1915) and Hartmeyer (1923) were unable to find other characters to justify segregating *Eugyra* (*sensu lato*) into three genera, and concluded that differences in mere number and position of the gonads were of specific rather than generic caliber. This conclusion appears to be reinforced by the finding of the new *Bostrichobranchus* which differs from *B. pilularis* most conspicuously in its possession of a gonad on the right side.

The second character that has been used in subdividing the eugyrids into genera is the presence and degree of development of secondary spirals on the pharynx. In molgulids, stigmata arranged in spirals which lie on the pharyngeal folds or are crossed by and closely associated with the internal longitudinal vessels are called primary spirals. Any spirals which may develop on the flat areas between folds, or, where folds are absent, between the internal longitudinal vessels and their rows of associated primary spirals, are termed secondary or accessory spirals. Accessory spirals are known to occur in some species of the molgulid genera *Molgula*, *Rhizomolgula*, *Paraeugyroides*, *Bostrichobranchus*, *Eugrya* (=*Eugyra* + *Eugyroides* + *Gamaster*), and probably *Paramolgula*. In all these genera except *Bostrichobranchus* the accessory spirals, when present at all, are small, even in older individuals, though in *Rhizomolgula* they may form small conical infundibula. The single feature which clearly distinguishes *Bostrichobranchus* from other eugyrids is the relatively tremendous development and multiplication of the accessory spirals, such that in all but very young individuals it is nearly impossible to distinguish primary from secondary spirals with any certainty. This condition is not even remotely approached in any other species possessing secondary spirals. In its development, however, the pharynx of *B. pilularis* passes through a stage which closely resembles the adult condition of most *Eugyra* species (Van Name, 1912), suggesting the derivation of *Bostrichobranchus* from an ancestral *Eugyra*-like form.

Hartmeyer (1911) recognized two species of *Bostrichobranchus*, *B. manhattensis* Traustedt, 1833, and *B. molguloides* Metcalf, 1900. Van Name (1912) showed these to be conspecific with *Molgula pilularis* Verrill, 1871, but retained Traustedt's genus *Bostrichobranchus* for this species. Since this work, *Bostrichobranchus* has received recognition as a full genus by Hartmeyer (1923), Huus (1937), and (with some reluctance) Van Name (1945). Huntsman (1912) pointed out the similarities of this genus with *Eugyra* and included it in the latter with the reservation that "it might be well to retain *Bostrichobranchus* as a subgenus, if there prove to be species more closely related to *E. pilularis* than to the typical members of the genus . . ." Ärnbäck (1928) pointed out that secondary infundibula were not unique in *B. pilularis*, and included this species in *Eugyra*. Van Name, who has studied *B. pilularis* more thoroughly than any other worker, concluded (1945) that *Bostrichobranchus* "is so close to the latter [*Eugyra*] that Huntsman's course has much to recommend it, but nevertheless the remarkable development of the accessory infundibula in the present group represents a distinct advance step in the evolution and specialization of the branchial sac which seems worthy of recognition in classification." He lists *Bostrichobranchus* as "Genus or Subgenus," giving preference to the former.

If segregation of *Bostrichobranchus* as a separate genus is suggested on the basis of one species, *B. pilularis*, such action appears to be much more strongly indicated with the discovery of the second and closely allied species *B. digonas*. Were the system of subdividing the eugyrids into genera on the basis of number and position of gonads followed here, it would be necessary to place *B. pilularis* in the genus *Eugyra* and *B. digonas* in *Eugyroides*. In view of the close structural similarity of the two species, such a generic separation would be untenable.

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# PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

## ANTHROPOLOGICAL SOCIETY

The Anthropological Society of Washington at its annual meeting on January 16, 1951, elected the following officers: President, WALDO R. WEDEL; Vice President, GEORGE M. FOSTER, Jr.; Secretary, WILLIAM H. GILBERT Jr. (reelected); Treasurer, MARGARET C. BLAKER (reelected); Councilors to the Board of Managers, CORNELIUS J. CONNOLLY (reelected), MARK HANNA WATKINS (reelected), MARION L. VANDERBILT, SIDNEY ADAMS, GEORGE TRAGER, JOHN C. EWERS; Representative to the Washington Academy of Sciences, WALDO R. WEDEL.

A report of the membership and activities of the Society since the last annual meeting follows: Life members, 1; Active members, 75; Associate members, 14; Total, 90. This represents a decrease of 7 since last year.

The members elected during the year were: Active members; Dr. GORDON MACGREGOR. Associate members; Dr. DAVID F. ABERLE, ROY G. BLANCK, JOSEPH B. CASAGRANDE, Miss ANNE FORBES.

The report of the Treasurer for the year ended December 31, 1950, follows:

*Credit:*

| | | |
|---|---|---|
| Cash in bank | | $282.31 |
| Income: | | |
| Dues collected | $95.00 | |
| Interest, Perpetual Building Association | $60.60 | |
| Dividend, Washington Sanitary Improvement Co. | $10.50 | |
| Dividends, Washington Sanitary Housing Co. | $16.00 | |
| Interest, U.S. Savings Bond | $12.50 | |
| Sales of old series *Anthropologists* | $18.71 | |
| | | $213.31 |
| Total | | $495.62 |

*Debit; Expenditures:*

| | | |
|---|---|---|
| AAA dues paid for Secretary, Treasurer, and one life member | $15.00 | |
| Dues forwarded to AAA | $10.00 | |
| Dues check returned for lack of funds | $6.00 | |
| Speakers' expenses | $119.00 | |
| Printing and mailing notices | $48.07 | |
| Secretary's expenses (postage) | $3.29 | |
| Treasurer's expenses (postage) | $1.00 | |
| Total | | $202.36 |
| Balance (in bank) | | $293.26 |

*Assets:*

| | | |
|---|---|---|
| Funds invested in Perpetual Building Association | $2,000.00 | |
| 2 shares Washington Sanitary Housing Co. (par value $100 per share) | $200.00 | |
| Sale of 42 shares @ $32 per share, Washington Sanitary Improvement Co. (less $3.15, expenses) authorized by Board of Managers February 14, 1950 | $1,340.85 | |
| U.S. Savings Bond, Series G | $500.00 | |
| Cash in bank | $1,634.11 | |
| Total as of Dec. 31, 1950 | | $5,674.96 |
| Total as of Dec. 31, 1949 | | $2,272.65 |

All regular meetings were held at the U.S. National Museum. Programs throughout the year were arranged by Dr. EUGENE C. WORMAN, Jr. Speakers and the titles of papers presented before the regular meetings of the Society in 1950 were:

January 17, GEORGE P. MURDOCK, *A field study of the people of Truk.*

February 21, RALPH S. SOLECKI, *On the trail of Ancient Man in northern Alaska* (slides).

March 21, DUNCAN EMRICH, *Folklore, an attempt at definition.*

April 18, ROBERT M. WHITE, *Some practical applications of physical anthropology.*

May 18, FRANK M. SETZLER, *Aboriginal Australia* (in conjunction with the Washington Academy of Sciences, motion pictures).

October 19, CORNELIUS OSGOOD, *The Koreans and their culture.*

November 21, SCHUYLER CAMMANN, *Tibet, the land and its people* (slides).

December 19, GEORGE M. FOSTER, JR., *Ethnographic impressions of Spain* (slides).

A new set of bylaws for the Society was presented by the Committee consisting of Dr. WILLIAM N. FENTON, Dr. REGINA FLANNERY, and Dr. T. DALE STEWART at a meeting of Board of Managers on October 31, 1950. The suggested revisions were adopted at the annual meeting of the Society on January 16, 1951, and are as follows:

1. Membership is reduced to one class, active, in place of the former life, associate, corresponding, honorary, and active.
2. Annual dues of all members are fixed at $1.50 a year, and provisions for subscription to the American Anthropologist are eliminated.
3. The officers plus six councilors and the chairman of the program committee take the place of of officers plus five councilors and ex-presidents of the Society as Board of Managers.
4. The President is limited to a 2-year term and the Vice President shall serve concurrently, with the same limitation.
5. Custodial duties of the Secretary are eliminated.
6. The Treasurer is exempted from payment of dues and from submitting quarterly lists to the editor of the *American Anthropologist* of members entitled to receive this periodical.
7. Councilors to the Board of Managers shall serve three years, each year two being replaced.
8. Prescription of exact time for meetings of Board of Managers is dropped.
9. The President is to appoint a Program Committee.
10. The President is to appoint a Nominating Committee of three in advance of the annual business meeting.
11. At the annual meeting two councilors to be elected or reelected, other officers to be elected or reelected.
12. Bylaws may be amended by all members without distinction of class of membership.

A report on possibilities for reinvestment of funds resulting from the sale of 42 shares of Washington Sanitary Improvement Co. stock was submitted to the Board of Managers at the regular November meeting of the Society. At the January 16 meeting in 1951 the Treasurer was authorized to invest said funds as suggested.

WILLIAM H. GILBERT, *Secretary.*

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